IMPERIAL AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

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breed, for example, yellow is absent from the body fat. Here again heredity and environment induce similar end results.

In many biological problems affecting human beings, science has had to look to botanists to lead the way. I need to remind you only of the original discovery of the mechanism of heredity by Mendel from his work on garden peas and its later independent rediscovery by three botanists. My interest in human individuality came from my experience with plants. It all started from a botanical problem in 1917 when we were trying to classify the colors of a segregating pedigree of Verbenas. A particular pink-flowered form was very fragrant to me but had absolutely no odor to my assistant. On the other hand, a certain red-flowered Verbena was fragrant to him but not to me. Some of the people in our laboratories agreed with me and some with my assistant. Only a very few found fragrance in both kinds of flowers.

Phenyl-thio-carbamide, which may be abbreviated to P.T.C., is a good reagent with which to show innate differences between people. Some of those we have tested need to have the solutions of P.T.C. more than 8,000 times as strong as others in order to taste it. The inability to taste the commercial crystals is inherited like blue eyes as a Mendelian recessive character, but different grades of taste acuteness have also been shown to be inherited. Numerous tests with other substances only emphasize the wide differences between people in their taste reactions. Some may remember the taste tests at the Richmond meeting when members of the association were asked to vote as to what the real taste of mannose is. They could not agree. Some voted tasteless, some bitter, some sweet and some voted sour or salt or some combinations of these tastes.

There are some interesting after-tastes. Over half the people after eating globe artichokes find the water tastes sweet, and tobacco smoke tastes sweet to some but not to all after the mouth has been rinsed with a solution of copper sulfate.

To the majority of people there are four primary tastes: sweet, sour, bitter and salt. A considerable number, however, we have found can not distinguish bitter from sour. To them quinine and vinegar taste alike. When these substances are weak they may be called sour and when they are strong bitter, but the taste is the same except for strength.

The individual reactions of taste are dependent primarily upon innate hereditary factors and the environment appears of relatively little importance. With smell the condition is quite the opposite. Probably even wider innate differences exist between people in their acuteness of smell than of taste, but environmental factors in abundance prevent the full expression of these hereditary differences. Thus age is a potent factor progressively dulling the sense of smell. A considerable number of people have lost their sense of smell entirely. Temporary conditions of a person, such as a cold in the head, may adversely affect his ability to smell. After being exposed to an odor for a time it becomes no longer perceptible. Olfactory fatigue apparently may be produced even by concentrations too weak to be detected. This is probably the explanation of asphyxiation of people by gradually increasing concentrations of gas which they never detected.

The sense of smell does not play as important a role in man as in many of the lower animals in bringing us info[illegible] world. There are not a n[illegible], however, who can distingu[illegible] odor in the same way in [illegible] individuals by smell alone. [illegible] t in children but is often retained into adult life when it is generally concealed on account of the social taboo against speaking of personal odors. Several parents have informed me that certain of their children when young by smelling a handkerchief they had picked up could tell to which member of the family it belonged, but this ability had been lost after they had grown up.

It is possible to learn something about the emotional response to sensory reactions. At a talk given a year ago before the Lancaster branch of the American Association for the Advancement of Science one half of the audience was supplied with powdered kaolin with a weak concentration of cuminol (0.33 per cent.) and the rest of the audience had kaolin in which the concentration was ten times as strong. Reactions of each person who could detect the odor were recorded as to whether it was pleasant, indifferent or unpleasant. When the odor was weak more found it pleasant than unpleasant, but when the odor was strong the reactions were reversed and more found it unpleasant than pleasant. (See Table 1.) This test, as well as other observations, demonstrates that strong odors

TABLE 1

TESTS OF CUMINOL POWDERS*
LANCASTER, PA., JANUARY 30, 1941
Cuminol dilute (0.33 per cent. in Kaolin)

Odor	Absent	Pleasant	Indifferent	Unpleasant	Total number
Males	6.03	31.90	47.41	14.66	116
Females ...	6.36	21.82	50.91	20.91	110
Totals	14	61	111	40	226
Per cent.	6.19	26.99	49.12	17.70	
Cuminol concentrated (3.3 per cent. in Kaolin)					
Males	2.92	24.09	35.77	37.23	137
Females ...	2.94	9.80	28.43	58.82	102
Totals	7	43	78	111	239
Per cent.	2.93	17.99	32.64	46.44	

* Individual reactions to odors are given in percentages.

tend to be disliked. It should not be forgotten, however, that what is weak to one may be strong to another because of innate differences and also because of environmental factors.

Of greatest influence upon our likes or dislikes for a given odor appear to be the pleasurable or unpleasurable associations which have been built up around it. We apparently ourselves once assisted in the development of an unpleasant association. In an early test of cuminol we had made the concentration much too strong, and the majority of the subjects disliked it. A few days later we tested the same persons with a very weak concentration. Several said, "Oh, that's the same as the awful smell you gave us before" and immediately called it unpleasant. Apparently some at least of these subjects had established an unpleasant association with the odor of cuminol when it was presented to them in strong concentration but would have considered it pleasant, or at least indifferent, if they had smelled it for the first time in a weak concentration. The likes and dislikes expressed for weak concentrations of cuminol may be due to associations with objects which are believed to give off similar odors. A wide variety of answers have been given to the question: What does cuminol smell like? They range from roses and citrus rind on the pleasurable side through caraway seeds to bedbugs and perspiration. The fact that one does not himself consider unpleasant those odors which are purely personal is an argument for the contention that there is no odor, aside from its strength and associations, which is intrinsically either pleasant or unpleasant.

Associations are especially powerful with the sense of smell, but they exist with all the senses. So long as we live we are building up associations and developing our personality through reactions with our environment which express themselves in likes and dislikes. Likes and dislikes are important determiners of our behavior.

The examples just given of the influence of heredity and environment have been taken from the senses of taste and smell. All the other senses are similarly subject to internal and external influence. I need only mention the innate differences in musical discrimination disclosed by Seashore and the progressive decrease, under the environmental influence of age, in the pitch or number of sound vibrations one can distinguish at a given intensity. There are a host of other responses which contribute to human individuality. Among these are the blood groups, the natural and acquired susceptibilities and immunities to disease and chemical substances, the allergies and the reactions to hormones and vitamins. The Binet and other mental tests have disclosed great differences between individuals in mental equipment.

It will be granted no doubt that there are great differences between people in their sensory judgments regarding the world in which they live and that these differences are influenced in varying degree by factors of both heredity and environment. Is this true of man's mental and spiritual judgments? I believe it is even more so. A few simple examples may be given.

At the end of the Lancaster meeting already referred to, the audience was asked to select the best title among five which had been suggested for the lecture just given. It might be thought that since all had

TABLE 2

Votes for Titles in Relation to Position on Ballot
Lancaster, Pa., January 30, 1941

	Titles	Position on Ballot*					Total votes	Per cent. of total	Rank
		1st	2nd	3rd	4th	5th			
Males	Why people differ	2.08 A	5.26 E	5.26 D	7.69 C	9.26 B	15	6.02	4
	Differences between people in taste and smell	44.44 B	70.83 A	63.16 E	59.65 D	69.23 C	152	61.04	1
	What makes differences in personality	1.92 C	14.81 B	6.25 A	5.26 E	8.77 D	19	7.63	3
	Demonstrations of heredity and environment	3.51 D	3.85 C	11.11 B	4.17 A	2.63 E	13	5.22	5
	Why each person lives in a different world	23.68 E	22.81 D	17.31 C	20.37 B	16.67 A	50	20.08	2
	Total number	37	59	45	53	55	249	99.99	
	Per cent.	14.86	23.69	18.07	21.29	22.09	100.00		
Females	Why people differ	8.70 A	2.17 E	10.53 D	9.30 C	8.57 B	16	7.69	3
	Differences between people in taste and smell	62.86 B	47.83 A	65.22 E	57.89 D	60.47 C	122	58.65	1
	What makes differences in personality	4.65 C	.... B	10.87 A	4.35 E	7.89 D	12	5.77	4
	Demonstrations of heredity and environment	5.26 D	 C	5.71 B	6.52 A	10.87 E	12	5.77	4
	Why each person lives in a different world	17.39 E	18.42 D	25.58 C	22.86 B	26.09 A	46	22.12	2
	Total number	38	30	52	39	49	208	100.00	
	Per cent.	18.27	14.42	25.00	18.75	23.56	100.00		

* Five titles were listed in different orders on five ballots A to E.
Numbers under each position are percentages of votes cast for given title on the ballot indicated by letter at right of figure.
Males: Ballot A was voted 48 times; B, 54 times; C, 52 times; D, 57 times; E, 38 times.
Females: Ballot A was voted 46 times; B, 35 times; C, 43 times; D, 38 times; E, 46 times.

heard the same lecture, there would have been considerable unanimity in preference. This was not the case, however. Though two titles had more votes than the others, each of the five titles was preferred by a considerable number. Here again we may be reasonably sure that factors of both heredity and environment did influence the mental judgments regarding the best title.

Unbeknown to the audience, the titles were in different orders on five different kinds of ballots which were shuffled before distribution. The records clearly show that there was no advantage so far as number of votes secured was concerned in having a title come first on the ballot. (For records see Table 2.)

A similar experiment with the same set of shuffled titles was earlier tried after a talk on taste and smell before an audience of 270 students at the Farmingdale Institute of Applied Agriculture on Long Island. Perhaps because the lecture, as well as the audience, was somewhat different, the percentages of votes cast for the various titles was considerably different from those in Lancaster. The position on the ballot, however, again did not seem to have any material effect on the voting. A different psychology might conceivably be involved in voting on questions in a referendum from that in voting for candidates in an election.

With the expectation of being able to show that position of candidates on a ballot would have no influence with a group of intelligent voters I next tried an experiment with scientists.

Under the authorization of the Executive Committee of the Association, a study is being made, in cooperation with Dr. Sewall Wright, of the effect of position of candidates' names on this year's preferential ballot for president of our association. There were four types of ballots sent out from the Washington office after they were properly shuffled. In one the names were arranged alphabetically; in the others the names were arranged at random, except for the first and last places for which names were selected on account of their high standing in last year's balloting.

We hope to publish a statistical analysis of the data at an early date. In the meantime, however, it will suffice to present some provisional conclusions from our arithmetical tabulation of the ballots received up to November 28th. (See Table 3.)

In all cases the percentage of votes for a candidate on the ballot in which his name came first or second was in excess of the average percentage he received on the other ballots. Other positions appear to have had little effect on the voting. If we use the excess in votes for a candidate in first or second place over his average in other positions as an index of the number of people who would not have voted for him if he had had a less desirable place on the ballot, then the percentage of votes due to preferred position on a given ballot range from 14.3 to 45.7 per cent. This would mean that between 3 and 4 per cent. or over 150 of the 4,000 members of the association who voted may have been influenced by the order of names on the ballot. (A biometrically more reliable measure of position effect on the ballots we hope to discuss in our joint paper, but it seems justifiable to use the suggested

TABLE 3

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
TABULATION OF BALLOTS FOR PRESIDENT, NOVEMBER 28, 1941
SELECTED NAMES TO SHOW POSITION EFFECT
F = Name *first* on ballot. S = Name *second* on ballot. L = Name *last* on ballot.

Nominee	Ballot 1	Ballot 2	Ballot 3	Ballot 4	Totals	Average excluding F or S	Estimated per cent. due to position
A	200 F	147	158 L	143	648		
Per cent. ..	18.85	14.73	15.94	14.80	16.14	15.16	19.58
F	38	59 F	40	36	173		
Per cent. ..	3.58	5.91	4.04	3.73	4.31	3.78	36.04
V	29 L	30	57 F	35	151		
Per cent. ..	2.73	3.01	5.75	3.62	3.76	3.12	45.74
Q	89	81 L	83	94 F	347		
Per cent. ..	8.39	8.12	8.38	9.73	8.64	8.30	14.70
B	91 S	65	73	79	308		
Per cent. ..	8.58	6.51	7.37	8.18	7.67	7.35	14.34
N	57	60 S	43	47	207		
Per cent. ..	5.37	6.01	4.34	4.87	5.15	4.86	19.13
L	58	73	72 S	50	253		
Per cent. ..	5.47	7.31	7.27	5.18	6.30	5.99	17.61
G	39	36	35	53 S	163		
Per cent. ..	3.68	3.61	3.53	5.49	4.06	3.61	34.24
O	30	35	31	31	127		
Per cent. ..	2.83	3.51	3.13	3.21	3.16		
Totals	1061	998	991	966	4016		
Per cent. ..	26.42	24.85	24.68	24.05	100.00		

provisional measure to point the trend of influence of position.)

To show that the position on ballot may possibly be of practical importance, we may compare the votes for two candidates who belong to the same section of the association and who would be generally considered rather closely comparable in age and in experience and eminence in both research and administration. The man whose name came first on one of the ballots stood two ranks ahead of the other candidate in total votes received. When, however, our correction was applied for his preferred position on the single ballot, he ranked one grade below the other candidate.

The fact that every one of the 22 candidates received a considerable number of votes is itself an indication of wide diversity in judgments of the voters. This may be attributed to differences in the fields of science represented and in the familiarity with the work of the various candidates. The balance between these environmental influences undoubtedly has a hereditary basis. That so many scientists should be influenced by such a trivial environmental difference as whether a candidate's name comes in the first two places or later in the ballot was unexpected. Those so influenced perhaps had a hereditary constitution different from the other voters. The results of the balloting of the American Association for the Advancement of Science show at least that we are not a class apart, uninfluenced by hereditary and environmental factors which sway the judgments of other people.

The Supreme Court of the United States is composed of outstanding minds. Their honesty is unquestioned and they are freed from even the unconscious pressure of political expediency. Here, if anywhere, we should expect unanimity. The Supreme Court, however, from its early history has rendered numerous decisions by a divided vote and in many instances, including some of the most important cases, by a majority of only one. With its broadly changed complexion since early New Deal days, one might expect less diversity in judgment at the present time. This does not seem to be the case judging from a last month's news report of the first two decision days of the present term. Within two weeks there were brought in three 5-to-4 and two 6-to-3 decisions. None of the justices during this time had failed to enter at least one dissent and all except two had more. We can not here attempt to analyze the elements in these differences in judgments. Such blanket terms as liberal and conservative suggest the influence of innate disposition and also of such environmental factors as advancing age. If we remember our experiments with taste and smell we may agree that judgments of drinkers regarding the taste of beer and judgments of the Supreme Court regarding issues of law can not help differing because men both are born different and have differences thrust upon them by their environment.

Differences in expression in art, music and literature can likewise be attributed to influences of heredity and environment. I have personally been interested in studying the manner in which trees have been used in art. Styles in method of representation are evident, but the artists differ in the way in which trees appeal to them. Some are interested in individual trees, others in groups. Some prefer trees in the foreground, others in the background or in the middle distance. There are differences also in the species of trees which different artists like best.

We have given examples of differences in plants and animals such that no two individuals are exactly alike and have classified the causes of these differences into the interacting factors of heredity and environment. We have shown that both heredity and environment are likewise responsible for the diversities in man, not only in his physical structure and sensory reactions but also in his mental and moral judgments. Every thought and act of our lives is influenced by these two factors. Man has used his knowledge of heredity and environment to mold plants and animals to his personal advantage. Can this be done with man himself? To some extent, yes, but the way is not so clear.

I know of no adequate evidence that man to-day is a better animal physically or mentally than at the dawn of history. While man's biological evolution during these five thousand years and more has seemed to lag, and at the present time has appeared to many to have been thrown into reverse, man's environment has changed markedly even within our own lives. Conscious control of human heredity, though a desired goal, will at best be slow even if our genetic knowledge were adequate for the task. Changing man's environment gives promise of more rapid betterment of human individuals, and in this effort we are far from reaching diminishing returns.

But the facts of individuality and the relative influence of heredity and environment upon personality must be carefully estimated in any rational campaign for permanent social betterment. Such knowledge has power to revolutionize our ideals and practice in social and religious justice, charity and education, methods of legislation and forms of government. Methods of education, for example, have been severely criticized for mass regulations which fail to take adequate account of individual excellences. Pedagogy has been called a racket, a pressure group which has forced legislation more in the interest of the pedagogical profession than in the interest of the individual students. Schools of education are accused of padding their curriculum in an attempt to compete in standing with other disciplines, and doctorates in education are considered inferior to those in other departments. This is strong language and may not be justified, but we have heard it repeatedly. Some of the criticisms are undoubtedly due to the difficulties inherent in the study of any subject in which variables are many and difficult to control. Similar criticisms come from the so-called exact sciences, mathematics, physics and chemistry, against the difficult, less exact biological sciences, botany and zoology, and some would even deny the name of science to those most difficult studies of man's social behavior. For years the educational world has been struggling with the problem of how best to deal with the increasingly recognized differences in mental ability, differences which, like those we have found in taste reactions, are of two kinds: a difference between general marked ability and general mediocrity and a difference between ability in certain lines such as mathematics, science, art or literature.

I recently wrote to the sixteen living past presidents of our association and asked them if they could satisfy the enclosed New York State requirements for teaching in the state secondary schools. Not one of the past presidents of the American Association for the Advancement of Science would be allowed to teach science in a New York high school without further preparation since none had taken the required instruction which included such subjects as the psychology, history, philosophy, principles and practice of education. One past president properly remarked that not all presidents would have been good secondary school teachers. It is a fact, however, that more than a quarter have had secondary school teaching experience, but could not now qualify under present requirements. This is not at the present time a serious deprivation of the freedom of these men, but some believe the state methods of selecting teachers place undue emphasis upon relatively unimportant requirements. Some educators have told us that in the balance between method and subject-matter they believed the pendulum had swung too far toward method.

Blanket regulations may make for ease of administration, but too great uniformity may preclude the assets of individuality. Uniform laws throughout the states would have certain advantages, but they might not be equally well adjusted to local environments and might prevent profitable experiments in local government. The increased means of communication throughout the world appear a mixed blessing. They tend to standardize our thoughts and behavior in a common mold but at the same time to decrease the material expressions of individuality available for social evolution through natural selection.

In the Imperial Valley of California some years ago the cantaloupe industry was on the point of ruin because of a fungus disease for which no adequate remedy was known. The problem was solved by bringing a gene for disease-resistance into the stock through hybridization with an inferior race from India. If only one variety had been grown throughout the world we would probably not now have the pleasure of eating cantaloupe for breakfast. Thus the cultivation of a single variety which is a high yielder may be of immediate advantage, but if grown exclusively it may cause the irreplaceable loss of genes of great value which are now combined in less desirable varieties.

Opposition to totalitarianism is not merely because it attacks man's rights but also because it suppresses his personality. Individuality is the kernel of democracy, the biological basis of the struggle for freedom. When we fight for individuality we fight on the side of nature. Recognition of individuality and all that it implies especially concerns us as scientists. Even if science were again persecuted and driven under cover, as it was in the middle ages, there would still be some brave inquiring minds. But science can not flourish without freedom of thought and its expression.

Why do I emphasize the value of individuality to science? Because I believe science is the great hope of mankind.

In speaking of science and scientists it should be clear I am not confining attention to the professionals. Whoever by observation or experimentation is responsible for increased knowledge of the world in which we live is a servant of science and contributes to the welfare of mankind. In this connection it is appropriate to mention that in colonial times keen observers had discovered the causal connection between barberry bushes and infestations of wheat rust and had passed laws in Massachusetts for the eradication of barberries long before botanists learned that a necessary stage in the life cycle of this rust is confined to the barberry.

Science is under fire for the suffering brought about by its applications, especially in the present war. Science is in no position to disavow its responsibilities in the problems of peace and war. As in epidemics of disease due to the ignorance of medicine we need not less but more medical knowledge, so in seeking a cure for the scourge of war we need not less but more science. The remedy we trust may ultimately be found by that most difficult of all biological sciences—the study of motives and human behavior. Science can reply to its critics that the applications of science are merely tools which men with good or bad motives use for their good or evil ends. The same can be said of printing. Even if we admit the responsibility of science for deaths due to its applications we will find that its applications have brought about even greater savings of life. The legend to a reproduction of the title page of Jenner's paper on vaccination published in 1798 reads: "The application of the facts presented in this paper has probably saved more lives than the total of all lives lost in war." The statement is easy to believe, since it has been estimated by Haggard that in the 100 years preceding Jenner's paper, sixty million people in Europe died of smallpox.

In war itself science has not been alone destructive, as may be seen from figures supplied by the Surgeon General's office regarding the annual death rate per thousand in the United States Army for the Mexican War, the Civil War and the first World War. Deaths due to battle injuries increased from 15 per thousand for the Mexican War through 33 for the Civil War to 53 for the World War. The death rate due to disease, however, decreased from 110 through 65 to 19 for the World War. The net result is that the total death rate actually declined, from 125 in the Mexican War through 98 in the Civil War to 72 per thousand in the World War. It is a satisfaction to feel that though implements of war have increased in destructiveness, those who are fighting to preserve our free way of life may not be subjected to greater risks than our forefathers assumed when they too fought for their country.

It can hardly be emphasized too strongly that it is not man's material comforts nor even the alleviation of his physical pains which are the greatest gifts of science to mankind. Science has freed men's minds. Foremost among liberating ideas is the belief that there is order and law in the universe and that this order can be discovered by questioning nature herself. Such belief was rare in the middle ages when processes of nature were generally attributed to supernatural causes: winds and storms to demons, comets and epidemics to the wrath of the Almighty toward a sinful world, and investigations of nature were persecuted by both church and state as Satanic magic and sacrilegious questioning of the acts of God. The Copernican theory widened our physical horizons and showed our earth a tiny speck in a universe of worlds. The theory of evolution brought a unity to our ideas of the organic world. The discovery of the mechanism of inheritance allowed an evaluation of the contributions of heredity and environment to the personality of individuals. The experimental method with adequate controls is the most valuable tool science has yet developed. Its understanding and use in daily life would mean more than all the scientific facts that schools can teach.

Science has helped to free man's soul. It has broadened the horizons of religion and given it a new point of view away from the old intolerant, materialistic theology when men sought their own salvation from selfish hope of heaven or fear of hell and persecuted or even killed those who did not conform to the authority of orthodox beliefs. Elimination of such incumbrances has left to religion a freer field for the cultivation of its great spiritual values. In this shrunken world all mankind are neighbors and our benefactions have had a world-wide view.

Science has banished much of ignorance and superstitution, but much remains. Recently in New York's Pennsylvania Station I purchased seven different magazines on astrology. One of them, and this not the best seller according to my newsdealer, I found had a monthly paid circulation of over 132,000 copies. (The circulation of our journal SCIENCE is about 15,000.) The readers of these astrological journals are part of our democracy and help to form the policies of our government. Other examples need not be given to show that the scientific method has not yet saturated our land.

If we consider past efforts to better mankind, it is clear that good intentions are untrustworthy criteria of service to humanity. The biblical criterion "By their fruits ye shall know them"—is biologically sound doctrine and still the best test. The attempts to suppress independent thought and study of nature in the middle ages, and up to the not distant past in our own country, were inspired by noble motives, but they put civilization back by many centuries. The crusaders had a lofty purpose but a trivial objective:—the capture of an empty tomb, with all too slight appreciation of the teachings of Him whom the tomb had held. The net result was unnecessary suffering and death even among a group of children who became involved.

Love of our neighbor is one of the loftiest ideals of the Christian faith. Sympathy and kindness toward those in need we can never do without—for our own sakes as well as for those who are helped. But charity covers a multitude of misplaced aims. It may attack symptoms merely rather than the cause of the ills to which it ministers and thus delay their cure.

During the plague of the seventeenth century when 25 million people or a quarter of the population of Europe died of this dread disease, there were doubtless, as there should have been, hospitals and other organized efforts to minister to the sick and dying. We can imagine the scant attention that would have been then paid a request for a grant for a scientific study of the life habits of such creatures as rats, fleas and the wriggling animalcules which Leeuwenhoek discovered at about this time in drops of putrid water. And yet our knowledge of rats, fleas and bacteria is one reason why centuries later pest hospitals are not found in London and we no longer dread the plague.

The illustration given is an example of the unsuspected value of knowledge in apparently unrelated fields. Many other examples could be given of the service of science to human welfare, a service which is often indirect. The ancients used human sacrifices to ensure bountiful harvests. Now we use commercial fertilizers for this purpose and find them more efficient. In the old days people fought yellow fever and smallpox by church rites and religious processions. Now we fight these diseases by killing mosquitoes and by vaccination. Formerly thousands of people were executed on the ground that they were witches. Science has proved that witchcraft does not exist. It would be difficult to give from history as striking examples of success in direct efforts to improve the condition of mankind without the aid of science.

Knowledge is power also in our efforts toward human betterment. We must learn the facts about the environment in which we live if we wish to adjust ourself into harmony with it. Efforts against nature are doomed to failure despite high motives. It is for this reason we believe that in a rational program for human betterment science—the free search for truth—is in the long run the best investment. If what I have said is true, it lays upon us all, both scientist and layman, a responsibility for the advancement of science, free and unhindered as a service to mankind. Think where we would have been now if in the dark ages men like Copernicus, Galileo, Albertus Magnus, Roger and Francis Bacon among other inquiring minds had been able to carry on their scientific investigations in an atmosphere of intellectual freedom. Our most difficult sciences might now have reached the stage occupied by biology, for example, and we might already have found a remedy for our present sick civilization.

How can science best be fostered? I need offer only a few suggestions.

Science in common with all intellectual pursuits needs tolerance, freedom from restraint and a recognition of the value of individuality. Men differ widely in their capacities for research. A great need therefore in the advancement of science, as of other intellectual endeavors, is to devise means for discovering the exceptional abilities at an early age and giving such abilities exceptional opportunities in order that their span of effective service with its social values may be prolonged.

The public, whom science serves, knows all too little what science really means. The magic and gadgetry of scientific applications rather than the methods and ideals of science make the great appeal. And yet the ideals and methods would help society reach judgments on the basis of ascertained facts rather than through emotional appeal and personal profit and would transform our daily lives if universally applied. Think what a change would come if our representatives in legislative halls should open each session with the prayer of Huxley: "God give me strength to face a fact though it slay me"—and really mean it.

A common comment of a layman after visiting a laboratory and having research explained to him is "what great patience scientists must have." The real thought appears to be how can reasonably intelligent men, as scientists seem to be, be content to spend time in such trivial and uninteresting details. The layman seems to feel as he might in watching a small child picking up little white pebbles laboriously one by one and putting them into a bucket and then taking them out again one by one in the same painstaking manner. And yet this same layman sees reason in taking a stick and whacking a diminutive white ball over a field, alone or in company with others, and each time he gets it into a little sunken bucket he takes it out again and whacks it to another bucket of the same dimensions. And when he has finally repeated this process 18 times he calls it an afternoon well employed and spends the evening telling his colleagues how he did it—provided he can find any colleagues who prefer to listen rather than to tell how they themselves whacked their own little white balls into 18 little sunken buckets. Or he may have to tell his story about what he did with his little white ball and the little sunken buckets to his patient wife, who can't get away. Science as well as golf is a sport to those who play the game and there is a chance of some bit of human value when the game is done.

In the promotion of human welfare through the advancement of science, scientists and the public have a common interest and may have a common share. I believe our association is especially adapted to furthering these common interests and could profitably undertake a study looking toward the development of a more effective program that would serve the aims of scientist and layman alike.

In this country as nowhere else patrons of art, literature and science have made investments in human good. The yields in benefits secured have varied much but sometimes have been slight because the investments have been unsound. We trust that those of philanthropic intent who wish to promote human welfare through the methods of science will subject their donations to as careful checks as they would a financial investment in order to ensure a profitable yield in the way of scientific dividends. A newly established National Science Fund is in position to serve as a clearing house for advice on the probable scientific dividends which may be expected from investments in science.

Although we do, each of us, live in different and more or less separate worlds of our own, I trust we shall ultimately be able to acquire a social organization as orderly as the constellations of other worlds. In our fight for individuality and freedom in this war and in the peace to come, I do not despair. The experimental method has demonstrated we must use force without stint to show that freedom and political morality as well as personal honesty really pay. We still cherish the faith that the free search for truth by the methods of science has power to rebuild the world and will prevail.

OBITUARY

ERNEST EVERETT JUST

AUGUST 14, 1883, TO OCTOBER 27, 1941

IT is a sad task to write this short memorial of my former student, collaborator and friend, Professor E. E. Just, of Howard University in Washington. His death was premature and his work unfinished; but his accomplishments were many and worthy of remembrance.

Professor Just was of the Negro race and undoubtedly the best investigator in the field of biology that his people has produced in America. In person he was tall and slender, of dignified mien, with fine, sensitive features. He was born in Charleston, South Carolina, on August 14, 1883. His mother, who was a teacher, after providing him with the best elementary education that his state could furnish, sent him to Kimball Union Academy in New Hampshire, where he made a very distinguished record. He then entered Dartmouth College.

Just took his A.B. degree at Dartmouth College in 1907. While there he specialized in zoology under William Patten, made an excellent record in courses, and devoted a good deal of time to a research problem; he was elected to Phi Beta Kappa and received special honors in zoology and history, as well as the only "magna cum laude" in his class. He began his graduate training at the Marine Biological Laboratory in 1909 with the course in marine invertebrates, and in 1910 in embryology. In 1911–1912 he acted as research assistant to the writer on the subject of fertilization and breeding habits in Nereis and the sea-urchin Arbacia. These experiences focussed his interest on marine eggs, which remained the center of his investigations throughout life. His duties at Howard University delayed the completion of his work for the Ph.D. degree at the University of Chicago until 1916. In the meantime he completed six papers, based on work at Woods Hole in the summer. This work was so good, and his efforts during the academic years to improve medical education at Howard and other Negro universities so effective, that as early as 1915 he received the first award of the Spingarn Medal presented annually to "The man or woman of African descent who shall have made the highest achievement during the preceding year, or years, in any honorable field of human endeavor."

He was on the staff of Howard University from 1907 to 1941, since 1912 head of the department of zoology. From 1909 to 1930, with the exception of two years, he spent all his summers in work at the Marine Biological Laboratory.

His first paper (1912) was an interesting study in which he showed by an ingenious method that the plane of symmetry of development is determined by the polar bodies and the point of entrance of the spermatozoon in a meridian of the spherical egg of the annelid Nereis. This was followed by about fifty papers in the next twenty-five years dealing with fertilization and experimental parthenogenesis in marine eggs, mostly of annelids and echinoderms, in addition to a number of theoretical contributions. In 1939 he published two books; the first, on "Basic Methods for Experiments in Eggs of Marine Animals" (89 pp., P. Blakiston's Son and Company, Philadelphia), is an account of the very refined methods that he had developed for work in this field; the second, on "The Biology of the Cell Surface" (392 pp., same publishers), brings together his work and thought in the fundamental field of cellular physiology.

In the twenty summer sessions that Just spent at the Marine Biological Laboratory at Woods Hole he became more widely acquainted with the embryological resources of the marine fauna than probably any other person; and he learned to handle the material with skill and understanding. In consequence, he was in great demand, especially by physiologists who knew their physics and chemistry better than biology, for advice and assistance which he rendered generously. When he withdrew from Woods Hole to work in European laboratories, his loss to the scientific community at Woods Hole was deeply felt.

Just maintained a fine sense of balance in his biological work: he believed that "the study of the state of being alive is confined to that organization which is peculiar to it," but that "life as an event lies in a combination of chemical stuffs exhibiting physical properties; and it is in this combination, *i.e.*, its behavior and activities, and in it alone that we can seek life." These statements are taken from the introduction to his book on "The Biology of the Cell Surface" published only two years before his death. The emphasis in his studies was always on the biological plane, though in his experiments he availed himself intelligently of physical and chemical techniques.

His technical papers were characterized by intimate knowledge of material and use of it in its optimum state; he was thus able to avoid the pitfall of failing to distinguish between results due to unphysiological initial conditions and the real object of his experiments, *viz.*, the effects of altered physical and chemical conditions.

His observations and deductions led him to emphasize the reactions of the cortex ("ectoplasm") of eggs, and to assert their primacy not only in the initiation, but also in the course of development. This is the main theme of his last book. He conceived that the behavior of the ectoplasm is one prime factor in differentiation during development, and the building up of nuclear material another; there is constant interplay of both with the general protoplasm. This led to an interpretation of the action of the gene in heredity, and the conception was even extended to interpretation of evolution. "As the boundary, the living mobile limit of the cell, the ectoplasm controls the integration between the living cell and all else external to it. . . . It is keyed to the outside world as no other part of the cell. It stands guard over the peculiar form of the living substance, is buffer against the attacks of the surroundings and the means of communication with it."[1] Just thus regarded the surface of the cell as something much more than the "semi-permeable membrane" of the physiologists.

Just's scientific career was a constant struggle for opportunity for research, the breath of his life. He was condemned by race to remain attached to a Negro institution unfitted by means and tradition to give full opportunity to ambitions such as his. For this condition no blame is to be attached to the institution, which indeed cooperated by constant and prolonged leaves of absence with Just's friends outside in securing support to enable him to carry on investigations elsewhere. It was due to the National Research Council, Mr. Julius Rosenwald, the General Education Board, the Carnegie Corporation and the Rosenwald Foundation that Just was enabled to spend the greater part of his scientific life during repeated leaves of absence in research, at first largely at the Marine Biological Laboratory, and in the last ten or twelve years in various European laboratories: in Germany at the Kaiser Wilhelm Institut für Biologie in Berlin, in France at the Sorbonne and marine stations and in Italy at the Naples Zoological Station. The successive fellowships and research awards bear witness to the high esteem in which he was held as scientist. All these appointments were limited as to time, and Just never experienced the security of a life appointment adequate to carry out his work.

An element of tragedy ran through all Just's scientific career due to the limitations imposed by being a Negro in America, to which he could make no lasting psychological adjustment in spite of earnest efforts on his part. The numerous grants for research did not compensate for failure to receive an appointment in one of the large universities or research institutes. He felt this as a social stigma, and hence unjust to a scientist of his recognized standing. In Europe he was received with universal kindness, and made to feel at home in every way; he did not experience social discrimination on account of his race, and this contributed greatly to his happiness there. Hence, in part at least, his prolonged self-imposed exile on many occasions. That a man of his ability, scientific devotion, and of such strong personal loyalties as he gave and received, should have been warped in the land of his birth must remain a matter for regret.

FRANK R. LILLIE

DEATHS AND MEMORIALS

DR. WALTER LINDSAY NILES, professor of medicine and acting dean of Cornell University Medical College, New York, died on December 23 in his sixty-fourth year.

DR. WILLIAM PITT DURFEE, emeritus professor of mathematics and emeritus dean of Hobart College, died on December 17 at the age of eighty-six years.

THE death is announced of Dr. Filippo Bottazzi, professor emeritus of physiology at the University of Naples. Dr. Bottazzi was president of the fourteenth International Congress of Physiology which was held in Rome from August 29 to September 3, 1932.

Nature reports the death on November 12, at the age of eighty-four years, of Dr. E. S. Beaven, the agricultural botanist and plant breeder.

A BRONZE plaque has been hung in the main building of the University of Texas School of Medicine, Galveston, in memory of the late Dr. Meyer Bodansky, who at the time of his death in June was professor of pathologic chemistry at the university. He had been a member of the faculty since 1919.

IT is reported in the *Journal* of the American Medical Association that a bronze statue of the late Drs. William J. and Charles H. Mayo in their surgical gowns will be the central point of interest of the Mayo Memorial Shrine to be erected in Rochester by residents of the city and Olmstead County. It will be placed on a granite base before a granite background in the central open space of an amphitheater, symbolic of operating rooms. The shrine, designed by James Earle Fraser, New York sculptor, will be separate from that being planned by the Minnesota Memorial Commission. This commission was appointed by Governor Stassen late in 1940 to study the establishment of a $250,000 fund for a memorial to the Mayos. State Senator William B. Richardson, Rochester, is chairman of the commission, which is composed of seventeen representative citizens of Minnesota.

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[1] "Biology of the Cell Surface," page 366.

SCIENTIFIC EVENTS

AN INDUCTION ACCELERATOR

THE University of Illinois announces that it has arranged for the installation of a machine which opens new fields for scientific exploration and which, as a super x-ray, has important possibilities in medicine, industry and national defense.

It was invented by Dr. Donald W. Kerst, of the department of physics. The machine is the second of its kind, and is ten times as powerful as the first machine, which was built a year ago. Dr. Kerst was given leave of absence to enable him to superintend its construction at the laboratories of the General Electric Company in Schenectady, N. Y.

The machine is called an induction accelerator. It accelerates electrons to an energy of twenty million volts and also emits x-rays of this power. This radiation exceeds that from the existing supply of radium. The x-ray radiation is twenty times as powerful as the x-ray machines now used in hospitals and factories. The machine will be installed at the university in the new Abbott power plant.

With the induction accelerator, electrons are accelerated to a speed nearly that of light—186,000 miles a second.

Dr. W. D. Coolidge, director of the laboratories of the General Electric Company, points out that the induction accelerator provides an important new tool for fundamental research. His statement reads:

> Hitherto, experiments with high velocity electron beams have not kept pace with experiments done with positive ions from the cyclotron. The cyclotron can not accelerate electrons, and previous devices able to do so have seemed to reach a practical limit at something like one fourth the energy output of the new induction accelerator built in the General Electric laboratories for the University of Illinois.
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> The induction accelerator seems to have no limit. Apparently its effective voltage can be increased indefinitely. It works not by applying the entire voltage at once, but by building up the speed throughout all revolutions.

It is announced that plans are now being considered for an induction accelerator to create 100- or 200-million volts energy.

THE NATIONAL INVENTORS COUNCIL

RECENT short-wave broadcasts from Europe and American responses thereto have centered attention upon the part which inventions are playing in the present war.

In response to this movement, Dr. William B. Coolidge, of the National Inventors Council of the Department of Commerce, stated that the council has already examined more than 35,000 inventions and suggestions during the past year, and that of those examined, several were of extreme import and might possibly affect modern warfare.

The inventions referred to include only those which have been received by the Inventors Council. When consideration is given to the work and achievements of the Office of Scientific Research and Development and of other Government agencies engaged in defense research and development work, it is apparent that the nation's inventive genius is contributing its share to the defense effort.

Lists have been made available by the War Department suggesting fields in which new ideas would be welcome. Among these are:

Hydrocarbon vapors as an explosive.
Rocket-propelled projectiles.
Air, centrifugal and electromagnet guns.
Automatic mines for land and sea.
Searchlights, mobile landing-field flood lighting.
Special automotive equipment for simplifying servicing of motor vehicles and aircraft, and improved motorized repair-shop equipment.
Improved tank design.
Better aircraft brakes.
Light, protective armored clothing.
Improved automatic anti-aircraft guns and small arms.
Aircraft catapults and retarding device.
Ice-prevention devices.
Refueling equipment.
Remote-controlled aerial and marine torpedoes, land vehicles and ships, and remote control for other combat weapons.
Improved gun- and bomb-sights, optical and otherwise.

THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

THE following statement has been received from the National Roster:

The National Roster of Scientific and Specialized Personnel is now conducting a survey of the senior and graduate students of chemistry and chemical engineering in the universities of the country. It is urged that all persons with training in this or any other scientific or professional field register with the National Roster as soon as possible.

The registers of this organization, containing the names of the scientific and professional individuals of the nation, are of the utmost importance in our present crisis. They must be replenished and kept current in order that there will always be a supply of trained men and women to handle any situation or carry on any research which is essential to our war effort. Registering with the National Roster is one way in which the trained individual can do his part. There may never arise an occasion where an individual would be asked by the Government to serve. On the other hand, there may be a time when persons with certain skills will be vital to the welfare of the nation either as full-time workers, part-time workers, or as consultants. Nothing has ever been lost through preparedness. *Therefore, it is again urged that all with special training register immediately with the National Roster of Scientific and Specialized Personnel at Washington, D. C.* This can be accomplished by writing to the National Roster of Scientific and Specialized Personnel in Washington, asking for necessary blanks. Also the required forms are being distributed to senior classmen in the country's colleges and universities.

THE LUCIUS N. LITTAUER FUND OF NEW YORK UNIVERSITY

NEW YORK UNIVERSITY has received nearly a quarter million dollars from Lucius N. Littauer. The gift will be used to establish "The Lucius N. Littauer Fund" in the College of Medicine. The income will be expended, as Mr. Littauer designated, "for research in psychiatry, neurology and related fields, in order to increase and diffuse knowledge of the biological and other factors which influence thought and conduct; and thereby to prevent and correct abnormal human behavior through experimental and clinical approaches."

A statement made by Chancellor Harry Woodburn Chase in regard to the gift, reads:

> A fair yet liberal part of the income will be devoted to fellowships for graduate students in medicine of superior ability, to be known as "Littauer Fellows," to be trained to practice psychiatry and those branches of medical science concerned with the activities of the mind and factors influencing it, thereby recruiting physicians specially devoted to the conservation and restoration of mental health.
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> We have a very deep appreciation of this generous gift by Mr. Littauer. For many years he has been interested in our College of Medicine and has given generously toward the support of special projects. This larger gift, coming at such a time, is heartening indeed. It is the first substantial gift which has been made to any university since our entry into the war and I can but see in it striking witness of the fact that intelligent and far-sighted citizens will not falter in their support of the purposes of higher education through this emergency.

Mr. Littauer had previously given the university nearly $120,000 for research on the prevention and cure of pneumonia; on venereal diseases, and for scholarships and fellowships in the College of Medicine, Washington Square College of Arts and Science, the College of Dentistry and other divisions of the university.

Mr. Littauer, president of the Gloversville Knitting Company and Fonda Glove Lining Company, is a former member of Congress from New York, and from 1912 to 1914 was a Regent of the University of the State of New York.

THE OBSERVATORY OF THE BUHL PLANETARIUM

THE Buhl Planetarium and Institute of Popular Science at Pittsburgh opened its new $30,000 People's Observatory on November 19. According to *Museum News*, the observatory is on the third floor of the planetarium, in two rooms separated from each other by a glass partition. The outer room, open to the air, contains the objective lens and mirror of a siderostat telescope; the inner room, kept at constant 72-degree temperature, contains the eyepiece and controls of the telescope. The objective lens, 10 inches in diameter, was made of glass imported from Europe and ground in America. There are six eyepieces ranging from 65 power to 490 power. A 12-foot horizontal steel tube supports the lens system and keeps out stray light. All this part of the telescope remains stationary. The image of the star or planet being observed is reflected to the lens by an aluminum-coated pyrex mirror 18 inches in diameter which can be set to follow automatically the movement of the celestial object. Nine electric motors power the control apparatus, which can direct the mirror to any part of the sky. The apparatus can even be set to find automatically the object wanted: the observer determines from a guidebook the celestial latitude and longitude of the object, sets the controls for that location, and starts the mirror moving; when the mirror stops the desired image appears in the eyepiece and a press on a button makes the mirror follow the movement of the object automatically. The observer stands or sits in a normal position and looks through the always horizontal apparatus; the mirror does all the adjusting. A recorded voice tells the spectator the story of the object being observed. The telescope was built by the Gaertner Scientific Corporation of Chicago.

The dedicatory address was delivered by Dr. Harlow Shapley, director of the Harvard College Observatory. Other addresses were made by William S. Linderman, president of the Buhl Foundation; Charles L. Lewis, director of the foundation and president of the planetarium, and Arthur L. Draper, director of the planetarium. The dedicatory program included a radio program by Dr. Shapley and Mr. Draper; a showing of the exhibit, "Can America Be Bombed?" from the Science Museum of the Saint Paul Institute, and a preview of a new sky show, "Bombers by Starlight," depicting by special apparatus, designed by the planetarium staff, the balloon barrage, blackout, fires started by bombs, glider and parachute attacks, and masses of aircraft overhead, with realistic sound effects recorded in London and Dover.

THE LIBRARY OF THE MARINE BIOLOGICAL LABORATORY AT WOODS HOLE

THE Carnegie Corporation of New York has recently granted to the Marine Biological Laboratory the sum of $25,000 to be used primarily to complete various back sets of journals and to add to its collection of books, particularly those which may be termed "classics" in biology and allied sciences. By means of this gift, the library, already notable for its periodicals, books and reprints, will presently be able to provide investigators with complete runs of all the important biological journals, and of many covering chemistry, physics, paleontology, radiology, medicine and other sciences allied to biology.

During recent years the library has enjoyed rapid growth. In 1920 the number of serials received was 153; now it is 1,257. The collection of reprints has increased from 8,500 to 120,000. So great was the expansion that the stack space provided in the building erected in 1925, and supposedly adequate for many years, was completely filled in 1940. At that time, the Rockefeller Foundation provided funds for a much-needed addition. The building, which more than doubles the original space, was quickly completed, and the serials and reprints were spread out in their more adequate quarters before the summer session of 1941. Every effort has been made to enable the reader to find for himself the volume that he wants. The journals are arranged in alphabetical order, and the reprints filed under the author's name. A complete bibliography of the author is thus instantly available. Commodious and well-lighted tables are conveniently located on each of the stack tiers in the new wing.

The library is in constant use, day and night, by those who are carrying on active research, and by an increasing number of those who come for the sole purpose of consulting biological literature. Thanks to the generosity of the Carnegie and Rockefeller Foundations, which have in former years greatly helped the Marine Biological Laboratory, the library is now adequately housed, and is enabled to increase its usefulness to the investigator.

THE MEDICAL MUSEUM OF THE ROCHESTER ACADEMY OF MEDICINE

ACCORDING to the *Journal* of the American Medical Association, the Rochester Academy of Medicine rededicated its medical museum to Dr. John R. Williams, chairman of the museum commission, on November 16. A reception to guests opened the program and speakers included Dr. William J. Merle Scott, president of the academy; Dr. George H. Whipple, professor of pathology and dean, University of Rochester School of Medicine and Dentistry; Dr. Walter B. Cannon, George Higginson professor of physiology and head of the department, Harvard Medical School, and Dr. Williams. The museum and auditorium are located in a new wing adjoining the academy, which was the gift in 1938 of the daughters of E. P. Lyon, in memory of their parents. A feature of the medical museum is a memorial frieze in which is recognized the fundamental contributions made by twenty-four North American scientific men in the past hundred and fifty years. Those honored in the frieze are: Dr. Benjamin Rush, Philadelphia; Dr. William Beaumont, St. Louis; Dr. Crawford W. Long, Athens, Ga.; Dr. William T. G. Morton, New York; Dr. Oliver Wendell Holmes, Cambridge, Mass.; Dr. Ephraim McDowell, Danville, Ky.; Dr. Silas Weir Mitchell, Philadelphia; Dr. Edward L. Trudeau, Saranac Lake, N. Y.; Dr. Theobald Smith, Princeton, N. J.; Dr. Howard T. Ricketts, Chicago; Dr. Hans Zinsser, Boston; Dr. Harvey Cushing, New Haven, Conn.; Lafayette B. Mendel, New Haven, Conn.; Elmer V. McCollum, Baltimore; Dr. William C. Gorgas, Washington, D. C.; Dr. Walter Reed, Washington, D. C.; Dr. Abraham Jacobi, New York; Dr. William Osler, Oxford, England; Dr. Walter B. Cannon, Boston; Dr. James B. Herrick, Chicago; Dr. Frederick G. Banting, Toronto; Dr. Charles H. Best, Toronto; Dr. George R. Minot, Boston, and Dr. Whipple.

Another feature is a mural in which is portrayed the contributions of medicine to modern civilization. There are in the museum twenty-three glass cases of priceless memorabilia. In 1936 the medical museum of the Rochester Academy of Medicine was organized as a division of the Rochester Museum of Arts and Sciences.

SCIENTIFIC NOTES AND NEWS

MEMBERS of the American Association for the Advancement of Science and of the Associated Scientific Societies meeting this week at Dallas under the presidency of Dr. Irving Langmuir, of the General Electric Company, were addressed on Monday evening by Dr. Albert F. Blakeslee, the retiring president, whose address appears in this issue of SCIENCE. Others of the more important addresses and papers presented at the meeting will be published in ensuing weeks. Dr. F. R. Moulton, the permanent secretary, expects to contribute an account of the meeting to the issue of SCIENCE of February 6, all the space of that number being reserved for it.

PRESIDENT E. O. LOVETT, of the Rice Institute, formerly professor of mathematics and astronomy at Princeton University, has retired with the title president emeritus at the age of seventy years.

VICE-PRESIDENT WALLACE, on behalf of President Roosevelt, presented on December 17 the 1940 Collier Aviation Trophy jointly to Dr. Sanford A. Moss, engineer of the General Electric Company, and to the Army Air Corps, for "outstanding success" in developing the turbo-supercharger, an engine device which makes possible high altitude flying.

THE *Journal* of the American Medical Association reports that Dr. Edward H. Juers, of Red Wing, Minn., recently received the annual medal of the Southern Minnesota Medical Association for his paper on epiploitis. The medal is given to the author of the paper considered best on the program of the annual meeting. The medal for a case history presented on the annual program was awarded to Dr. Peter E. Hermanson, of Hendricks, whose report dealt with a case of pregnancy occurring outside of the uterus.

THE first Charles Chree medal and prize of the Physical Society of London has been awarded to Professor Sydney Chapman, of the Imperial College of Science and Technology.

E. A. HOLBROOK, dean of the Schools of Engineering and Mines at the University of Pittsburgh, was elected at the Pittsburgh meeting president of the National Society of Professional Engineers, succeeding John H. Beretta, of San Antonio, Texas. Other officers elected were Samuel I. Sacks, Philadelphia; Alfred E. Roche, Troy; William R. Wolfe, Muskogee, Okla., and Joseph H. Morgan, Urbana, Ill., *vice-presidents,* and Colonel Walter L. Simpson, Army Engineering Corps, *treasurer.*

THE *Bulletin* of the American Mathematical Society reports that Associate Professor R. V. Churchill, of the University of Michigan, is on leave of absence for the first semester of 1941–42 and is visiting lecturer at the University of Wisconsin. Assistant Professor C. H. Fischer, of Wayne University, is this year visiting assistant professor of mathematics at the University of Michigan.

DR. GEORGE L. GRAHAM, of the Rockefeller Institute for Medical Research, Princeton, N. J., on December 18 addressed the Zoology-Entomology Seminar of Kansas State College on "Biological Studies with the Nematode *Strongyloides ratti.*"

DR. WALTER L. PALMER, professor of medicine of the School of Medicine of the University of Chicago, delivered on December 3 the fifty-fourth Thomas Dent Mutter Lecture before the College of Physicians of Philadelphia. His subject was "The Rôle of Acid Gastric Juice in Gastric and Duodenal Ulceration."

DR. KENDALL B. CORBIN, associate professor of anatomy, histology and embryology at the College of Medicine of the University of Tennessee, has been appointed chief of the division of anatomy, histology and embryology and acting head of the department of anatomy. He succeeds the late Dr. August H. Wittenborg, who also served as professor of anatomy at the school.

DR. THOMAS D. SPEIDEL, editor of *The Journal of Dental Education* and formerly of the Iowa State University, has joined the faculty of the School of Dentistry of Indiana University.

DR. CARL A. NAU, formerly director of the Texas Division of Industrial Hygiene, has become professor of physiology and preventive medicine and head of the department at the School of Medicine of the University of Texas.

DR. GEORGE F. FORSTER, assistant chief of the Division of Laboratories in the Illinois Department of Public Health, has been appointed associate professor of bacteriology in the Loyola University School of Medicine.

DR. CHARLES RAY, JR., research fellow of the Blandy Experimental Farm, has been appointed geneticist at the Central Fibre Corporation, Pisgah Forest, N. C. Dr. Ray has been awarded the second prize by the Walker Prize Committee for his paper on "Cytological and Genetic Studies on the Flax Genus, *Linum.*"

HARRY L. ERLICHER, vice-president of the General Electric Company in charge of purchasing activities, has been named a member of the Defense Industries Advisory Committee of the Copper and Zinc Industries, a division of the Office of Production Management.

Dean Harvey, materials engineer, Engineering Laboratories and Standards Department, Westinghouse Electric and Manufacturing Company, is serving on a part-time basis on loan from his company as consultant in the Specifications Branch of the Bureau of Industrial Conservation, his services having been requested by the director of the bureau, Lessing Rosenwald.

Emeritus Professor Ralph Stockman has been elected a vice-president and Professor E. W. H. Cruickshank and Sir J. Donald Pollock have been made members of the council of the Royal Society of Edinburgh.

The Ohio State University Monthly reports that Dr. N. Paul Hudson, chairman of the department of bacteriology, has returned to the university after a year's leave of absence spent in London as a representative of the Rockefeller Foundation, in a collaborative scheme with the British to distribute influenza vaccine. He was associated there with the National Institute of Medical Research, Hampstead.

Señor G. A. Jorquera, professor of agricultural chemistry in the School of Chemical Engineering, University of Concepcion, Chile, is spending the academic year 1941–42 at the Oregon State College as a Phi Beta Kappa fellow. He is engaged in work leading to an advanced degree in chemistry and chemical engineering.

Major Thomas Coulson, director of public relations of the Franklin Institute, will address a public meeting of the Philadelphia Branch of the American Association of Scientific Workers on January 16 at 8:15 P.M. His subject will be "The Franklin Institute, Its Purposes, Achievements and Problems."

Matthew W. Stirling, chief of the U. S. Bureau of American Ethnology at the Smithsonian Institution, delivered on November 27 before the Washington Academy of Sciences an illustrated address entitled "Treasure Trove of Mexican Archeology."

Dr. William Seifriz, professor of botany at the University of Pennsylvania, lectured on December 2 before the Torrey Botanical Club at the American Museum of Natural History, New York. His subject was "Recent Advances in the Study of Protoplasm."

Dr. Karl F. Meyer, of the George Williams Hooper Foundation for Medical Research, University of California, San Francisco, gave an address before the Minnesota Pathological Society on December 16. He spoke on "The Animal Kingdom, a Reservoir of Infection." The society was addressed on November 18 by Dr. Melvin H. Knisely, Chicago, on "Effects of Plasmodium Malariae on the Blood Vascular System."

The twenty-fourth annual meeting of the American Society of Mammalogists will be held at the American Museum of Natural History, New York City, from Tuesday, March 31, to Saturday, April 4. Titles of papers for presentation at the meeting must be in the hands of the corresponding secretary of the society, Emmet T. Hooper, of the Museum of Zoology of the University of Michigan, before March 1. Those submitting titles should include an abstract of the paper, the time required for presentation and the projection apparatus needed. Further details regarding the meeting may be obtained from the corresponding secretary or from the local committee on arrangements: H. C. Raven, *chairman*, Edwin H. Colbert, John Eric Hill and Claude Leister, of the American Museum of Natural History, New York.

A forum sponsored by the New York branch of the American Association of Scientific Workers on Venereal Disease Problems in the Army and Civilian Defense Areas will be held on January 7 at 8:15 P.M. at the Men's Faculty Club, Columbia University. The speakers will be Lieutenant Colonel Edward H. Marsh, Office of the Surgeon, 2nd Corps Area, U. S. Army, and Dr. Roger E. Heering, P. A. Surgeon, U. S. Public Health Service, District No. 1. Dr. Ernst P. Boas, assistant professor of clinical medicine, College of Physicians and Surgeons, Columbia University, will act as chairman.

The American Congress on Obstetrics and Gynecology will be held in St. Louis from April 6 to 10. The committee sponsoring the congress has attempted to unite the efforts of voluntary and other agencies to carry out plans for the care of women and children. The directors believe that, notwithstanding the war situation, the congress should be held at the stated time. Inquiries may be addressed to the central office, 650 Rush St., Chicago, Ill.

During the first year of the war, the British Genetical Society, which has a membership of 146, held only its annual meeting. From the summer of 1941 it has resumed its normal activities. Two successful meetings have been held at the Rothamsted Experimental Station and at Oxford. On each occasion papers were read and a considerable series of exhibits were demonstrated. Although winter meetings are still impossible, it is hoped to commence a full program next year with a meeting in the early spring. The present officers of the society are: *President*, R. A. Fisher; *Vice-presidents*, C. D. Darlington, J. S. Huxley, R. N. Salaman; *Treasurer*, E. R. Saunders; *Secretaries*, K. Mather, E. B. Ford.

THE National Live Stock and Meat Board will place grants and establish fellowships through the National Research Council for the purpose of increasing the present knowledge of nutrition. The grants may be made either for fundamental or for clinical research on the nutritional properties of meat, meat products and animal fats, and the importance of these nutrients to human health and welfare. This fund will become available on July 1. Applications will be received until March 1. Application blanks may be obtained from the Division of Biology and Agriculture, the National Research Council, 2101 Constitution Avenue, Washington, D. C. In addition to a statement of the problem and research plan or program, the committee in charge desires information regarding the method of attack proposed, the institutional support which will be given the investigation and the uses to be made of the sum requested. No part of a grant may be used by the recipient institution for administrative expenses.

THE Graduate School of the University of Illinois has established four research fellowships in the fields of medicine and dentistry in Chicago at a stipend of $1,200 per year. Fellows are eligible for reappointment in competition with the new applicants. Candidates for these fellowships must have completed a training of not less than eight years beyond high-school graduation. Formal application blanks may be secured from the Secretary of the Committee on Graduate Work in Medicine and Dentistry, 1853 W. Polk Street, Chicago, Illinois.

THE General Education Board of New York City has granted $53,750 to the Louisiana State University for the use of the department of forestry. Of this amount $23,750 will be used for equipment and $30,000 for research, the latter to be expended over a period of three years and to be paid to the university semi-annually. The grant will provide funds for completing the equipment of three utilization laboratories and it is said will give the unit "the most complete utilization equipment, both for teaching and research, of any forestry school in the South." It is planned to study forest land tenure and the effect of such tenure on forestry practices.

PAUL KOLLSMAN, of Greenwich, Conn., the aircraft instrument inventor, has established a fund of $65,000 to endow a library for lending aeronautical books to students of aviation.

Nature states that under the will of Alfred Corner, London, who died in 1934, the university has received £1,440 for the purposes of the Cambridge University Biochemical Laboratory. The full value of the bequest, of which this is an instalment, may approach £1,800.

THE Hungarian Ministry of Internal Affairs has established at Budapest a new institute for research in proper feeding. The building and equipment are modern and will accommodate two hundred country doctors, who will attend courses in the science of nutrition. The staff of the institute comprises clinicians, chemical experts, economists and financial experts.

THE Imperial Agricultural Bureaux, Aberystwyth, Wales, has decided that for the sake of increased efficiency and economy, all work connected with subscriptions, sales and distribution of the journals and other publications of the majority of the bureaux should now be centered in one office. For this purpose, a Central Sales Branch has been organized, with its offices at the Agricultural Research Building, Penglais, Aberystwyth. In future all correspondence dealing with sales and distribution should, with the exceptions noted below, be so addressed. Correspondence on all other matters must still be addressed to the deputy director of the bureau in question. The only publications not dealt with by the Central Sales Branch are those of the Imperial Institute of Entomology (The Assistant Director, Imperial Institute of Entomology, 41 Queen's Gate, London, S.W.7) and the Imperial Mycological Institute (Director, Imperial Mycological Institute, Ferry Lane, Kew, Surrey), and *Nutrition Abstracts and Reviews* (Secretary, Imperial Bureau of Animal Nutrition, Rowett Institute, Bucksburn, Aberdeen).

DISCUSSION

SYMBOLS FOR HUMAN GENES

STANDARDIZATION of symbols for human genes has desirable aspects, as Dr. Strandskov[1] suggests. An International Committee for the symbolizing of genes and chromosome aberrations in all genetic work met in London in August, 1939, and drew up certain rules which have been published.[2] The committee also had under consideration the definition of all genetical terms, but owing to the war that work has not been completed. The Committee on Mouse Genetics Nomenclature has also published a report.[3] The symbols recommended in these reports are not quite the same as those which Dr. Strandskov advocates. For instance, + is used as a superscript to the symbol for the "wild" type.

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[1] SCIENCE, 94: 366, 1941.

[2] *Jour. of Hered.*, 31: 27, 1940.

[3] *Jour. of Hered.*, 31: 505, 1940.

These symbols are at least in part applicable to human genetics, but they were drawn up with the needs of experimental genetics particularly in view; and it would be unwise to try to hasten their adoption in human genetics except where their use would help to clarify a particular genetical situation. While there are groups of human alleles which might with advantage receive this symbolization, there are many more where the question of allelomorphism is by no means settled, so that the bulk of such cases must await fuller knowledge.

While it is generally agreed that the AB blood groups are alleles, yet I think the choice of the blood groups as a field to which the new nomenclature should be applied was particularly unfortunate. In the first place, the final form which blood group genetics may take is by no means certain; for instance, as regards the nature of the O and the relations of the A_1, A_2, A_3 and B_1, B_2, B_3 sub-groups. This can perhaps be most clearly seen by consulting, for example, the recent paper of Hirszfeld and Kostuch.[4]

A decade ago anthropologists and serologists adopted internationally the symbols O, A, B, AB for the four human blood groups. These are preferable to the I, II, III, IV schemes of Moss and of Jansky, which partly conflict with each other and have been the source of serious and even fatal errors in connection with blood transfusion in hospitals. The medical profession appears to be gradually giving up this number system and adopting the safer and better ABO system, which is sufficiently genetical for their purposes. It can not be expected that medical practitioners and anthropologists will have an expert knowledge of genetics, although a general knowledge is of course highly desirable.

Geneticists should therefore endeavor to hasten the spread of the ABO system in medical circles. The adoption by geneticists of a new and obscure set of symbols for the blood groups would defeat this end and make their papers on the subject unintelligible to the anthropologists and medical men, for whom the genetical aspects of blood group work should have the greatest appeal.

R. RUGGLES GATES

UNIVERSITY OF LONDON,
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SOME FIELD OBSERVATIONS BEARING ON THE ORIGIN OF THE MORRISON "GASTROLITHS"

DESPITE numerous finds of genuine gastroliths in association with remains of fossil vertebrates, a causal relationship between the dinosaurs and so-called "gizzard-stones" of the Morrison formation remains doubtful. The origin of these brilliantly colored and highly polished stones has been speculated upon by numerous observers and opinion has been divided among various theories, not the least attractive and popular of which attributes the polish to the mechanical and chemical action of dinosaurian digestion.

Recent field work, sponsored by the William Berryman Scott Research Fund, on the larger problems of Morrison stratigraphy over extensive areas in Utah, Colorado and southern Wyoming has brought out several facts regarding the distribution and occurrence of these stones which may be significant:

(*a*) Within the Morrison the association of dinosaur remains and "gastroliths" seems entirely fortuitous. Where tremendous quantities of fossil bones are found as at the *Dinosaur National Monument*, near Jensen, Utah; at the Malcolm Lloyd Jr. quarry near Cleveland, Utah, and at the Como Bluff and Bone Cabin quarries in southern Wyoming there is no unusual concentration of "gastroliths." In fact, during recent excavations at the Lloyd quarry not a single stomach-stone was found among the remains of a dozen or more dinosaurs, including *Antrodemus*, *Ceratosaurus*, *Stegosaurus*, *Ornitholestes*, *Camptosaurus* and two large sauropods. Furthermore, great quantities of "gastroliths" may occur, constituting at places a veritable conglomerate, without fossil bones being in evidence.

(*b*) In the Colorado Plateau the "gastroliths" occur only in the upper portion of the Morrison in beds which are relatively barren of fossils and which show some lithic differences from the underlying fossiliferous portion of that formation. "Gastroliths" are found most abundantly in thin zones or "stringers" near the base of this upper unit. The rock types making up the "gastroliths" are identical with those found in a persistent but thin conglomerate between the two units just mentioned and the inference seems logical that regardless of the origin of their polish the stones were derived from the same source as the conglomerate or from the conglomerate itself.

(*c*) The distribution of the "gastroliths" is by no means coextensive with the Morrison formation as none were found in that formation south of a line running roughly from the Henry Mountains, Utah, to the Black Canyon of the Gunnison River in Colorado. Likewise a hurried search failed to reveal any east of the Front Range. The geographical distribution seems to coincide quite closely with that of the conglomerate noted above. Dinosaur bones, however, are present in the usual numbers in regions where "gastroliths" are absent.

The facts listed above, in conjunction with others apparent from a close comparison of the "gastroliths" of the Morrison with undoubted stomach-stones, seem unfavorable to the dinosaur hypothesis, but it is admitted that there are many peculiar facts of distribution which are difficult to explain by any theory.

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[4] Über das Wesen der Blutgruppe O. *Klin. Wochenschr.*, 17: 1047–51, 1938.

The field relationships suggest that the "gastroliths" were originally stream or pediment gravels and that the high polish was superimposed by the action of wind-blown dust upon surfaces already smoothed and rounded by other agencies. It should be noted that the Morrison shales are highly bentonitic and must have contained a high proportion of sharp, volcanic, glass shards which would have been very potent abrasives at the time of deposition. The stones probably accumulated by deflation in the same manner as modern "desert armor" and the bright coloration may be due to prolonged exposure to weathering. The lack of faceting, case hardening and pitting is by no means a fatal objection as these seem to result from local and specialized conditions and do not always accompany wind erosion.

Until a connection between the dinosaurs and these highly polished stones is proved it seems advisable to abandon the term "gastroliths" in favor of some non-committal designation. The term "Morrison stones" may be used in a sense analogous to the "Gobi stones" of the Asiatic Irdin Manha formation, the two occurrences being in many ways similar.

W. LEE STOKES

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THE SMYRNA FIG IN CALIFORNIA

IN SCIENCE (94: 339), it is stated that Dr. Gustav Eisen introduced the Smyrna fig into California. This is an error. Cuttings from Smyrna were brought into California at the instance of G. P. Rixford, in 1880, and also in much earlier years, perhaps in the 1850's, by other persons of whom there is no record. None of these trees matured fruit, which led Dr. Eisen to believe the failure was due to lack of pollination (caprification), a surmise confirmed by an experiment in artificial pollination first made by George C. Roeding at Fresno in 1890. Pollen from a caprifig tree was inserted with a goose quill in young figs of a Smyrna tree. The figs matured and became fully ripe. Eisen himself, in 1895, carried pollen from caprifigs, in a sealed glass container, to Smyrna fig trees two hundred miles distant in the upper San Joaquin Valley in Kern County and pollinated young figs. This experiment proved completely the need of caprification. In the course of time Eisen and his former associate, Mr. Roeding, interested the United States Department of Agriculture in the problem and through the department's agents a colony of the blastophaga wasp was sent from Algiers to California in 1898. The introduction of the wasp proved successful and the growing of Smyrna figs was soon established on a commercial basis. Blastophagae had been previously introduced by fig growers but apparently were a failure.

Eisen's monograph on the biology of the fig[1] may be considered classical and is still consulted by students and by horticulturists.

WILLIS LINN JEPSON

UNIVERSITY OF CALIFORNIA

AEDES AEGYPTI LINNAEUS, THE YELLOW FEVER MOSQUITO, IN CENTRAL MISSOURI

LATE in September mosquito larvae were found in a small aquarium in the office of the State Health Commissioner. These were taken to the Laboratory of the State Department of Health where, on October 4, 1941, an adult emerged that proved to be of this species.

This location, Jefferson City, is near the center of the state, about 38.6 degrees north latitude, and probably is the "fartherest north" for the species in Missouri.

C. F. ADAMS

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QUOTATIONS

THE WORK OF THE ROCKEFELLER FOUNDATION IN BRAZIL

THE twenty-fifth anniversary of the beginning of the work of the International Health Board of the Rockefeller Foundation in Brazil has been enthusiastically commemorated. Besides articles in newspapers and in medical magazines, some medical associations have held special meetings to honor that humanitarian institution. The most brilliant of these meetings was one promoted by the oldest medical association of Brazil, the National Academy of Medicine. Under the chairmanship of Professor Aloysio de Castro of the University of Rio de Janeiro Medical School the academy held a crowded meeting to honor the Rockefeller Foundation in the person of Dr. Fred L. Soper, its representative in Brazil. The principal speaker was Dr. Afranio Peixoto, professor of hygiene at the university, who reviewed the most salient facts in the services rendered by the foundation especially in the fields of medical education, public health nursing, instruction of sanitarians and the investigation and control of yellow fever, malaria and hookworm disease. Two medical commissions were sent to Brazil early in 1916, the first under Major

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[1] Proceedings of the California Academy of Sciences, ser. 2, 5: 897–1003, 1896.

General William C. Gorgas, to study the yellow fever situation, and the second, composed of Drs. Richard M. Pearce, John A. Ferrel and Bailey K. Ashford, to survey the grounds of medical education, hospitals and dispensaries, public health agencies and sanitary progress. In the same year an effective cooperation began with the Brazilian National Department of Health and with the São Paulo University, growing little by little and leading to the great development resulting in the medical and public health institutions and services now in operation. One lasting result of this cooperation is the University of São Paulo School of Medicine, now housed in a magnificent building of many stories and provided with a faculty of distinguished professors. It is a long work begun with the cooperation of Drs. Samuel T. Darling and Wilson G. Smillie, whose services were an honor to American medical science. To-day the São Paulo school is one of the best on the American continent, and its department of hygiene is a leading institute of scientific research in the country. In the field of public health too the cooperation of the Rockefeller Foundation was of the greatest value. The work against hookworm disease begun in 1916 and greatly developed since 1920 has led to the creation of many modern county health units. With the cooperation of the foundation in 1922 the first training school for nurses was founded in Rio de Janiero, and a Nursing Division was started in the department of health of the city with an able body of ten American public health nurses as supervisors. This led to the creation of a few training schools for nurses in several cities of a large country where the professionally trained nurse was completely unknown before. The nursing service of the department of health of Rio de Janeiro is now an efficient and popular modern agency of health. With the help of the International Health Board of the Rockefeller Foundation, the School of Hygiene and Public Health of the Johns Hopkins University lent the services of two able professors, Drs. Allen W. Freeman and James A. Doull, to start a course of instruction for sanitarians in the medical school of Rio de Janeiro, and the foundation granted fellowships to many Brazilian public health workers, who went to the United States to study at leading American schools and to visit different public health organizations.

With the support of the Rockefeller Foundation a complete survey of the yellow fever situation developed in the discovery of the jungle form of the disease, the disclosure of sylvatic mosquito vectors other than Aedes aegypti (as *Hemagogus capricorni* and Aedes escapularis), the invention of the viscerotome as the leading means of postmortem diagnosis of yellow fever and, through the work of the Rockefeller Institute, the creation of an efficient vaccine, now injected into millions of people, thus protected against the sylvatic yellow fever, as the only practical prophylactic resource. Brazil is also indebted to the Rockefeller Foundation for the help in the fight against Anopheles gambiae, the worst vector of malaria, imported into Brazil from the west coast of Africa. Some species of anopheles are more susceptible to infection than others; some anopheles mosquitoes will not bite man at all; others will bite man only when other animals are not available. Anopheles gambiae of Africa, which had spread through the states of Rio Grande do Norte and Ceara, entering the great airport of Natal, Brazil, has probably the highest infectibility and the greatest preference for man of all Anophelines. This makes that species the most important vector of malaria in man. The intensive campaign against the gambiae conducted by the malaria service of the Brazilian health department with assistance in funds and personnel from the International Health Board of the Rockefeller Foundation is an outstanding example of "species sanitation." The measures concentrated on were those which would prevent the breeding of gambiae. The eradication of the imported Anopheles gambiae is a paramount example of what is possible through the use of modern antimalarial technic, available to the Brazilian health authorities through the invaluable cooperation of the Rockefeller specialists.

Professor Peixoto praised the humanitarian work of the Rockefeller Foundation in Brazil and commended Dr. Soper for his ability to win the friendship of Brazilian physicians, thus insuring once more the unity of the Americas.—*Rio de Janeiro Correspondent of the Journal of the American Medical Association.*

SOCIETIES AND MEETINGS

THE CRYSTALLOGRAPHIC SOCIETY

A STATED meeting of the Crystallographic Society was held on November 17, 1941, in Room 4-345, Massachusetts Institute of Technology, Cambridge, Mass. Twenty-six members were present. The proposed constitution and by-laws were discussed and approved, and the organization was placed on a formal basis. The following officers were elected for 1941–42: Professor Martin J. Buerger, *President;* Professor Harry Berman, *Vice-President;* Dr. Clifford Frondel, *Secretary-Treasurer.* At the close of the business meeting, Mr. Joseph Lukesh spoke of work carried on jointly by him and M. J. Buerger on "The Tridymite Problem." The talk was followed by a lively discussion bearing on the geological implications of the unusual thermal behavior reported, and on the mechanism of formation of super-structures based on silica frameworks. The speaker's abstract of his talk follows:

THE TRIDYMITE PROBLEM

Crystals of tridymite from Plumas County, California, have been investigated by the Weissenberg method. The diffraction symmetry of the low temperature form is *mmm*. It is based upon a face-centered orthorhombic lattice, the cell having the following dimensions:

$a_0 = 9.91$Å $\quad b_0 = 17.18$Å $\quad c_0 = 81.57$Å

Possible space groups include *Fmm*, *Fmmm* and *F222*. The abnormal length of the *c* axis prompted investigation of tridymite from other localities. A sample from San Cristobal, Mexico, was found to have the same *a* and *b* axes, but the *c* axis was one half as long. The *c* axis rotation patterns of the two materials were substantially identical as regards distribution and relative intensities of all reflections except that the intermediate layer lines found on the pattern of the Plumas County material were missing on the pattern of the San Cristobal material.

Spectroscopic and chemical analyses of the Plumas County tridymite indicate a high impurity content, with an empirical formula approximating $NaCaAl_3Si_{15}O_{36}$. The presence of the impurity atoms is believed to be the cause of the doubled *c* axis.

Attempts were made using a controlled-temperature Weissenberg camera to locate the two inversions of tridymite at 117° C. and 163° C. as determined by Fenner from thermal observations on artificial material. The Plumas County material inverted directly from the low form to the high form at 127° C. with no evidence of a middle form. The tridymite from San Cristobal showed two inversions, low to middle at 121° C. and middle to high at 135° C. The absence of a middle form in the case of the Plumas County material and the smaller temperature range than expected in the case of the San Cristobal material are attributed to the presence of impurities.

Weissenberg patterns of the Plumas County tridymite were taken just above the inversion. In addition to the pattern to be expected from the hexagonal silica framework, there was found superimposed an orthorhombic pattern of satellite reflections which varied in their distribution in a definite manner with temperature, but not with time. The sequence was not reversible, and once it had been carried through to completion, it could not be obtained again on the same crystal. A similar, but less complicated, sequence was found using the material from San Cristobal. The presence and the behavior of the satellite reflections can be explained by the migration of the impurity atoms from positions taken at the time of formation of the crystals, when electrostatic forces only were satisfied, to positions taken during heating that are more compatible with packing requirements. It appears that both the Plumas County and the San Cristobal tridymite must have formed below 121° C. and 127° C., respectively, inasmuch as the temperature inversions are irreversible.

CLIFFORD FRONDEL,
Secretary

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE twenty-third annual meeting of the New Hampshire Academy of Science was held at the University of New Hampshire, Durham, on Friday and Saturday, November 14–15, 1941. At the Friday evening session, Professor Herbert E. Warfel of the university and the State Fish and Game Department presented the principal address, "Biological Basis for Fish Management in New Hampshire." Several reels of motion pictures of scientific interest were shown.

Saturday morning was given over to the reading of nine different papers by members, in the fields of geology, botany, ecology and anatomy. On Saturday afternoon, two papers were read in the field of meteorology.

At the annual business meeting, it was voted to award the grant-in-aid for the current year from the American Association for the Advancement of Science to Mr. Paul R. Doe, of Spaulding High School, Rochester, N. H., for a continuation of his work with time-lapse photography.

The following officers were elected for 1941–42: *President*, Dr. Charles D. Howard, State Board of Health, Concord; *Vice-president*, Professor Guy Williams, Colby Junior College; *Secretary-Treasurer*, Dr. Robert H. Denison, Wilson Museum, Dartmouth College; *Councilors*, Professor J. H. Gerould, Dartmouth College, for three years, and Professor Donald Chapman, University of New Hampshire, for four years; *representative* to the Academy Conference, W. W. Ballard, Dartmouth College.

The Executive Council voted to hold the next annual meeting at Keene, N. H., in the fall of 1942.

The address of the retiring president, Professor Bancroft H. Brown, of Dartmouth College, was on "Teaching and Research in a Democracy."

W. W. BALLARD,
Retiring Secretary

REPORTS

THE NEW ENGLAND FIELD GEOLOGISTS

THE thirty-seventh annual field meeting of the New England Field Geologists was held on October 10, 11 and 12, at Northampton, Mass. The headquarters for the meeting was in Seelye Hall, Smith College. Dr. Robert Balk, of Mount Holyoke College, was in charge of the meeting, which was attended by 170 persons, representing 35 colleges.

Various sites of Triassic fossils were visited on Friday afternoon in the vicinity of South Hadley. Dinosaur footprints were viewed at two localities. Specimens of conifer remains were obtained in the Longmeadow sandstone. Miss Christine Lochman was the leader of this trip.

Dr. Balk led a party on Saturday which visited the fossil locality of Bernardston, Mass., from which the only identifiable fossil, according to G. A. Cooper, is *Spirifer divaricatus* of Onondaga age. The relations of the Bernardston formation to the older phyllites and slates were discussed, and the succession of rocks within the Bernardston formation was demonstrated. The rocks crop out mainly on the west side of the Connecticut River, but at a few places, typical phyllite and amphibolite appear east of the river. Outcrops of phyllite, one half mile from outcropping Pelham granitic gneiss (Carboniferous age) shows no effects of injection. A series of metamorphosed sediments east of the Pelham gneiss and outcrops of gneiss along the valley of Millers River were also visited.

R. H. Jahns and M. E. Willard, of the U. S. Geological Survey, conducted an all-day excursion on Saturday to examine sections of Quaternary deposits in the Connecticut Valley between Northampton and Turners Falls. The chief points of interest included outwash forms deposited in, and adjacent to, the great pre-glacial Connecticut valley lake, varved-clay bottom deposits and glacial spillways. The structure and morphology of the deltas and their relations to nearby ice-contact forms were demonstrated and their significance discussed. The relations, areal and vertical, of the glacial spillways to the adjacent outwash deposits were pointed out.

Three excursions were conducted on Sunday, October 12. M. E. Willard led one group in a study of the variations in rock types of the Triassic in the Connecticut Valley north of the Holyoke Range. The significance of these variations as they bear on the nature of the topography of the Triassic floor of deposition was discussed. Data obtained at exposures of a basal Triassic talus breccia together with information obtained from drill records indicate that the Triassic area of deposition is divided into two parts: namely, west of the present Connecticut River there was a deep north-south basin of deposition; and to the east there was a similar, but much shallower basin. It was suggested that the break between these two basins represented a now-buried fault scarp.

Miss Lochman led a group that studied two varved-clay localities. Special attention was directed to the problems of the Pleistocene *vs.* Recent slumping phenomena: the character and mode of formation of the zone of disturbed varves found at the top of each section: the extent and significance of crumpled zones and the significance of different colorations of the clay layers.

A study of the geology of Winsor (Quabbin) dam was conducted by a group led by Dr. Balk on Sunday morning. The contact exposures of a series of chloritic schists and an offshoot of the Belchertown tonalite were studied in the spillway. The general geology of the huge reservoir was described from the observation tower on top of Quabbin Hill. Exposures of metamorphosed volcanics on the northeast slope of the hill and injection gneisses in the eastern portion of the reservoir were also studied.

The 1942 field meeting of the group will be held in eastern Massachusetts under the leadership of Robert Nichols, of Tufts College, and Dr. L. W. Currier, of the U. S. Geological Survey.

LLOYD W. FISHER,
Permanent Secretary

LEWISTON, MAINE

SYMPOSIUM ON FOLSOM-YUMA PROBLEMS

An informal symposium on the Folsom-Yuma and other problems related to Early Man in North America, especially in the Southwest, was held on September 3 and 4, 1941, at the Laboratory of Anthropology, Santa Fe, New Mexico. To this meeting, sponsored jointly by the University Museum (University of Pennsylvania) and the Laboratory of Anthropology, Santa Fe, were invited those interested in the various phases of this complex of problems. Happily, many amateurs, or local archeologists, as well as the strictly professional men attended.

During the morning (E. B. Howard, *chairman*) and afternoon (F. H. H. Roberts, Jr., *chairman*) sessions on September 3, discussion was primarily directed to the problem of nomenclature of the Folsom, Yuma and similar points. It was proposed, after the discussion, that a committee be chosen to prepare a resolution embodying the conclusions of the informal discussion. This committee, composed of Dr. E. B. Howard, Dr. F. H. H. Roberts, Jr., and Marie Wormington, drew up resolutions, which were passed by unanimous vote at the morning session (Marie Wormington, *chairman*), on September 4.

These resolutions have been circulated among those present at the meeting for further consideration and final approval and to those interested workers who were unable to attend.

During the morning session, September 4, numerous problems were thrown open to general discussion. Such matters as the possible spurious Folsom points, reported especially from southeastern Colorado, and the importance of detailed geologic interpretation and correlation of archeological sites were considered.

The success of the meeting as an open forum for the discussion of problems relating to Early Man has made all who attended hope for the establishment of an annual summer meeting, for which Santa Fe seems so admirably situated. Especial thanks for the success of this meeting are due Dr. E. B. Howard, of the University Museum, Philadelphia, Pa., who was responsible for the planning and organization, and to the staff of the Laboratory of Anthropology at Santa Fe, who acted as hosts.

LOUIS L. RAY
MICHIGAN STATE COLLEGE

SPECIAL ARTICLES

THE SUSCEPTIBILITY OF THE EASTERN COTTON RAT, SIGMODON HISPIDUS HISPIDUS, TO EUROPEAN TYPHUS

ONE of the outstanding difficulties in the study of typhus fever has been the lack of an animal in which the disease could be reproduced as it occurs in man. With this in mind, a search for more suitable experimental animals for the study of typhus was undertaken, and our results obtained with the eastern cotton rat, *Sigmodon hispidus hispidus*, are presented below. After these studies were under way, we discovered that Gerardo Varela[1] had already tested the susceptibility of these rodents to murine typhus. Although Varela was able to demonstrate the infectivity of the cotton rat brain as late as 5 days after inoculation, the rats themselves apparently remained healthy.

In our experiments the European typhus rickettsiae used were the well-known old Breinl strain and also three new strains isolated from patients in Madrid about 6 months ago during a recent epidemic of typhus.

Yolk sac membranes of developing chick embryos inoculated with typhus rickettsiae according to Cox's technique[2] served as the source of the infectious material for this study. In an experiment using cotton rats between 25 and 30 gm in weight, the smallest volume of a 10 per cent. yolk sac suspension given intraperitoneally which resulted in death was between 0.05 and 0.5 cc. By the intracardial and intranasal routes the minimal lethal dose was approximately 0.01 cc. At autopsy, rickettsiae were found in great abundance in the peritoneal exudate of the rats inoculated intraperitoneally; in the pericardial and mediastinal exudate of those injected intracardially; and in the lungs of those infected intranasally.

A striking relation between age of rats and their susceptibility to typhus was observed. In an experiment with eight cotton rats of different sizes given 0.1 cc of a 10 per cent. yolk sac suspension intracardially, those weighing 20 to 30 gm died in 3 or 4 days, whereas those weighing from 46 to 66 gm recovered from the infection after several days of experimental disease.

To determine whether the fatal infection in young rats could be prevented by a specific immune serum, samples of normal and convalescent human serum were mixed with equal volumes of a 20 per cent. infected yolk sac suspension. The mixtures were incubated for 1 hour at 38° C. and a group of the rats inoculated intracardially with each mixture. The convalescent serum used in this experiment had been obtained from patients 2 weeks after recovery from typical typhus. A portion of the 20 per cent. yolk sac suspension alone was similarly heated for 1 hour at 38° C., after which tenfold dilutions were made and groups of rats inoculated intracardially to serve as infectivity controls. The six rats receiving the convalescent serum survived, whereas the six which received normal serum succumbed 3 or 4 days after inoculation. The titration of the yolk suspension alone showed that the number of minimal lethal doses given each rat in this test with normal or convalescent serum was somewhere between 5 and 50.

In the cotton rats that succumbed to the intracardial injection of infected yolk sac the greatest number of rickettsiae was observed in the mediastinal exudate. The rickettsiae were also numerous in the liver. This organ was chosen as a source material for the serial passages of the infection in the rats. The Madrid-1 strain has now been carried through five passages. After four serial passages it produced fatal infection in all of three rats inoculated intracardially with 0.2 cc of a 10 per cent. liver suspension. The same volume of a 1 per cent. suspension likewise resulted in the death of all rats, whereas the animals given 0.1 per cent. suspension showed only slight evidence of experimental disease. By routes other than the intracardial a fatal infection in serial passage was not obtained.

Although it is obvious that a still more susceptible animal is needed, the results above indicate that the cotton rat is much more suitable than the guinea pig for the investigation of many problems in typhus fever which urgently await solution.

J. C. SNYDER
C. R. ANDERSON
LABORATORIES OF THE INTERNATIONAL
HEALTH DIVISION,
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[1] Gerardo Varela, *Medicina* (Mexico), 13: 171, 1933.

[2] H. R. Cox, *Public Health Reports, U.S.P.H.S.*, 53: 2241, 1938; 55: 110, 1940.

THE NERVE-MODULUS FOR ANESTHETICS

FOR some years this laboratory has examined the quantitative effects of local anesthetics upon nerve action-potentials. Full details of apparatus and methods will be published elsewhere. It was found that for sciatic nerve of *R. Pipiens*

$$T \log R = Z$$

when:

T is the elapsed time in minutes between the application of the anesthetic and a decrease in action potential of 80 per cent.

R is the ratio $\dfrac{\text{molarity}-\text{minimum effective molarity}}{\text{minimum effective molarity}}$

Z is a constant.

We propose to call the quantity Z the nerve-modulus for local anesthetics. It was found closely to approximate 5.50 for five local anesthetics of unrelated chemical structures.

In the determination of local anesthetic-potency it is a common practice to use the minimal effective concentration (Mm) as a criterion of potency. Mm is frequently determined by successively testing solutions of decreasing concentrations. Because the relationship between block-time and molarity is hyperbolic the experimental determination of the minimum effective concentration presents practical difficulties. The use of the modulus Z renders this procedure unnecessary as from it the minimum effective concentration can be readily calculated.

Thus

$$\text{Log } R = \frac{Z}{T}$$

$$R = \log^{-1} \frac{Z}{T}$$

and

$$R = \frac{M_1 - Mm}{Mm}$$

$$Mm = \frac{M_1}{1 + \log^{-1} \dfrac{Z}{T}}$$

or more conveniently (and because Z = 5.50)

$$Mm = \frac{M_1}{1 + \text{antilog} \left(\dfrac{5.50}{T}\right)}$$

Thus in comparing an anesthetic with procain the ratio:

$$\frac{M_1 \left(1 + \log^{-1} \dfrac{Z}{T_2}\right)}{M_2 \left(1 + \log^{-1} \dfrac{Z}{T_1}\right)} = P$$

When:

M_1 = molarity of procain
M_2 = molarity of anesthetic tested
T_1 = block-time for procain
T_2 = block-time for anesthetic tested
Z = modulus or 5.5
P = potency (relative to procain)

Consequently the minimum effective concentration of procain and the unknown may be compared without the determination of the Mm of either. When anesthetics differing widely in potency are compared it is not usually possible to use equimolar concentrations in testing them, because an effective concentration of one will be either too concentrated or too dilute for the other.

The modulus permits direct comparison of solutions of unlike molarities. To correct the block-time for differences in nerve-diameters the standard nerve diameter was arbitrarily taken as 500 micra. The block-time for a given molarity was found to vary as the square of the diameter of the nerve. Therefore it is a simple matter to correct an observed block-time to that for a standard nerve of 500 μ. In practice a concentration of anesthetic is selected that causes 80 per cent. block in from 3.5 to 12 minutes. Higher concentrations give inaccurate results because when excess anesthetic is present the molar/time relationship is not valid. Lower concentrations yielding long block-times are inconvenient for the same reason that renders the determination of Mm difficult. When a number of determinations of T have been made for one or more values of M the times are corrected to standard diameter, averaged, and Mm calculated. The validity of Mm can then be checked by direct experiment. When this is done, 45 minutes is arbitrarily taken as the time in which a decrease in the action potential must be observed in order for the concentration to be considered minimal. In the five anesthetics tested Mm calculated from Z closely corresponded with the experimentally determined values.

For anesthetics having prolonged action such as Nupercain the calculated Mm was found to exceed the determined Mm. These anesthetics block nerve-conduction for much longer periods than those for which the modulus was found to hold, recovery-time in some instances being as long as 3 or 4 hours contrasted with 30 minutes or less for anesthetics such as cocain and procain. The modulus proves useful in making rapid preliminary tests of new compounds. When it is found that the recovery time after 80 per cent. block is longer than 30 minutes, the calculated Mm should be checked by direct experiment before attempting to use the modulus to calculate the relative potency P. Further experiments are in progress.

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THE QUANTITATIVE RELATIONSHIP OF RIBOFLAVIN TO CATARACT FORMATION IN RATS

NUTRITIONAL cataract in rats due to avitaminosis was first described by Day, Langston and O'Brien.[1]

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[1] P. L. Day, W. C. Langston and C. S. O'Brien, *Amer. Jour. Ophth.*, 14: 1005, 1931.

Later Bessey and Wolbach[2] described other ocular changes due to Vitamin G deficiency but reported that cataract occurred in only a small percentage of their animals. El Sadr[3] observed both the corneal opacity, vascularization and cataract reported by the above workers. Day, Darby and Langston[4] subsequently identified riboflavin as the cataract preventive factor.

Since these workers had used different rations and since their results were varied, a series of experiments was undertaken to explain the inconsistency of cataract formation in rats fed on riboflavin deficient diets.

Sixty rats were placed on the diet of Bourquin and Sherman.[5] A microbiological assay by the method of Snell and Strong[6] showed this ration to contain riboflavin in such amounts that our animals received 0.57 micrograms per day on the basis of average food consumption. Another group of fifty animals was placed on a modified ration of Bourquin and Sherman in which the B-complex was supplied by adding sufficient amounts of crystalline thiamin, pyridoxin, nicotinic acid, pantothenic acid and choline, instead of the 80 per cent. alcoholic extract of wheat. Some of these animals were supplemented with varied amounts of riboflavin while others received only the basal ration.

A third group of twenty animals was placed on a riboflavin free diet in which 14 per cent. Crisco was used as a source of fat instead of the 8 per cent. filtered butter fat used in the Bourquin-Sherman diet. The animals on this ration were supplemented with 50 gamma thiamin, 20 gamma pyridoxin, 200 gamma nicotinic acid, 100 gamma pantothenic acid and 5 milligrams choline per rat per day.

The results of these experiments variously corroborate all the work done on riboflavin deficiency as it affects the eyes of rats. Corneal opacity and vascularization occurred in all animals except those receiving adequate amounts of riboflavin. Cataract occurred in 90 per cent. of the animals on the Bourquin-Sherman diet within 9 weeks.

On the modified ration, 85 per cent. of the animals receiving between 1 and 3 micrograms of riboflavin daily developed cataract in 10 weeks. On the modified ration without the riboflavin, only 14 per cent. of the animals exhibited cataract formation. The time periods in each case were comparable, *i.e.*, cataract had developed in the animals receiving small amounts of riboflavin at a period when the negative controls were alive and exhibiting some growth but without the development of cataract.

All the animals on the third ration failed to develop cataract within twelve weeks after which they were discarded.

These results indicate that rats on a ration devoid of riboflavin do not exhibit cataract. Minute amounts of riboflavin induce cataract formation and rations containing more nearly adequate amounts are noncataractogenic. This would explain the inconsistency reported by various workers of cataract production on rations which were deficient but not entirely riboflavin free. Our results are also in agreement with the observations of Stokstad and Manning[7] on the incidence of the curled toe paralysis syndrome in chicks. These findings demonstrated a lack of curled toe paralysis except when small amounts of riboflavin were present. A more complete report of these findings will appear elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TEST-TUBE SPIRAL ABSORPTION VESSEL

A SIMPLE, efficient and inexpensive vessel for carbon dioxide absorption has been constructed and extensively used for plant respiration measurements. As seen in Fig. 1, this absorption cell has the added advantage of compactness. This feature is obtained by the use of a test-tube for the shell of the apparatus.

The nucleus around which the absorption cell is built consists of a glass spiral through which a chain of gas bubbles moves in contact with the absorbing solution. This spiral tube lengthens the path of the bubbles and thus prolongs the time of contact between the gas and the solution. By this means, increased efficiency of absorption is obtained. Apparatus built upon this principle have been described, heretofore, by Harvey and Regeimbal,[1] and also by many other designers of similar apparatus.

As indicated in Fig. 1, the apparatus includes a test-tube (b) fitted with a two-hole rubber stopper (a) through which pass a long inlet tube and a short outlet tube. The inlet tube is bent just below the rubber stopper so that its longer portion is centered in the test-tube. The lower end of the inlet tube is drawn out to form a short nozzle (d), which is bent sharply upward. A spiral of glass tubing (c), open at both ends, fits loosely over the upturned nozzle. As the carbon-dioxide laden air stream passes through the nozzle and enters the spiral in the form of bubbles, some of the absorbing liquid also enters the spiral. This results in a continuous circulation of liquid, both through the spiral tube in which the absorption takes place and in the test-tube itself.

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[2] O. A. Bessey and S. B. Wolbach, *Jour. Exp. Med.*, 69: 1, 1939.

[3] M. M. El Sadr, *Chem. and Ind.*, 58: 1020, 1939.

[4] P. L. Day, W. J. Darby and W. C. Langston, *Jour. Nutrition*, 13: 389, 1937.

[5] A. Bourquin and H. C. Sherman, *Jour. Amer. Chem. Soc.*, 53: 3501, 1931.

[6] E. E. Snell and F. M. Strong, *Ind. and Eng. Chem.* (Anal. Ed.), 11: 346, 1939.

[7] E. L. R. Stokstad and P. D. Manning, *Jour. Nutrition*, 16: 279, 1938.

[1] R. B. Harvey and L. O. Regeimbal, *Plant Physiol.*, 1: 205–206, 1926.

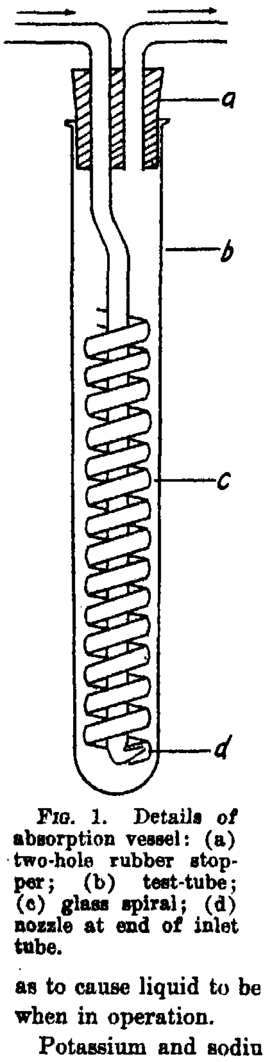

FIG. 1. Details of absorption vessel: (a) two-hole rubber stopper; (b) test-tube; (c) glass spiral; (d) nozzle at end of inlet tube.

The spiral may be formed of glass tubing softened in the flame of a blast lamp and turned around a piece of brass tubing of the proper size. A slight taper on the brass tube makes for ease in the removal of the glass spiral after turning.

Two sizes of these absorption vessels have been constructed and used in respiration studies. The smaller one holds 25 ml of solution and consists of a 22 × 175 mm test-tube with spiral and inlet tube made of 6 mm tubing. The spiral is 18 mm in diameter and 105 mm in length. The larger vessel utilizes a 25 × 200 mm test-tube with proportionately larger spiral and inlet tube. This absorption vessel holds 50 ml of solution. In all cases, the volume of the absorbing solution should be sufficient to cover the top of the spiral but should not be so great as to cause liquid to be forced up into the outlet tube when in operation.

Potassium and sodium hydroxide solutions of 0.10 and 0.05 normality have been successfully used as carbon-dioxide absorbents with this apparatus. Solutions of barium hydroxide are not recommended because of a tendency to block the inlet nozzle with precipitated carbonate. At the end of a run, the absorption vessel is disconnected and tilted so as to drain out the alkali solution through the outlet tube into a small flask. This flask should then be stoppered to protect the solution from atmospheric carbon dioxide. Aliquots may be pipetted from this solution and titrated in the presence of excess barium chloride against phenolphthalein with dilute standard hydrochloric acid (0.10 or 0.05 N). The addition of barium chloride in excess results in the precipitation of the absorbed carbon dioxide as barium carbonate previous to the titration. Acid titration values thus obtained give a measure of the unused hydroxide and, in comparison with corresponding values obtained with the original solution, give an accurate index of the carbon dioxide absorption.

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A SIMPLE METHOD OF REMOVING SCALES FROM LARGE LEPIDOPTERA

CONSIDERABLE difficulty is usually experienced in removing scales from the bodies of large thickly clothed Heterocera in preparation for morphological study. The following method has been used successfully by the writer with specimens of the tobacco hornworm (*Protoparce sexta* (Johan.)). This method can be used effectively with either fresh or dried specimens, although fresh specimens are denuded more easily. The wings are removed and the scales are dislodged from the body by brushing with a small toothbrush. A child's brush with moderately stiff bristles, all of approximately equal length, will be found best for this purpose. Stroking is most effective over the soft chitin of the abdomen, while a reciprocating motion produces better results on the head and thorax.

Fine scales on the legs and wings can not be removed readily by brushing. These parts may be cleaned easily by placing them in a 5.25 per cent. solution of sodium hypochlorite for a short period. They should be removed and rinsed in distilled water not over two hours after immersion in this solution.

A. H. MADDEN

BUREAU OF ENTOMOLOGY AND
PLANT QUARANTINE

BOOKS RECEIVED

STEINBECK, JOHN and E. F. SHERWOOD. *Sea of Cortez.* Illustrated. Pp. 596. The Viking Press. $5.00.

WARNER, W. LLOYD and PAUL S. LUNT. *The Social Life of a Modern Community.* Pp. xii + 460. Yale University Press. $4.00.

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EQUILIBRIUM THERMODYNAMICS AND BIOLOGICAL CHEMISTRY[1, 2]

By Professor GEORGE SCATCHARD

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Since science progresses by building block upon block, it is important to examine the structure from time to time to make sure that there are no badly fitted blocks, none which are being made to carry more than their proper capacity and none which might be made more useful. This is particularly true when thermodynamics, which is a vast and variegated structure erected upon the simple bases of the two laws of thermodynamics, is applied in biology and biological chemistry to systems so much more complicated than those in which its results have been tested by physical chemists. Yet such an examination is discouraged because we are so certain of the foundation on the two laws of thermodynamics as laid out by J. Willard Gibbs.

I see no reason to question the validity of the two laws of thermodynamics, even for vital processes, and the only mistake I know in Gibbs's great paper is a trivial typographical error. However, a close examination shows that the foundation we are using is not exactly the one laid out by Gibbs. A discussion

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[1] Address of the retiring vice-president and chairman of the Section on Chemistry, American Association for the Advancement of Science, Dallas, Texas, December 29, 1941.

[2] Contribution from the Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology, No. 498.

of the main ideas, without details and without mathematics, may bring out the differences and show how to minimize any difficulties which may arise from them.

From the fact that a system with constant energy which approaches equilibrium must increase in entropy, Gibbs derives two criteria of equilibrium. The first is that in a system in equilibrium there is no possible change which will increase the entropy at constant energy. The second and more useful one is that in a system in equilibrium there is no possible change which will decrease the energy at constant entropy. He then introduces a new function which he calls the potential or, more specifically, the intrinsic or chemical potential. He defines the chemical potential of a substance in a system as the derivative of the energy of the system with respect to the quantity of that substance when the entropy and volume of the system and the quantities of other components are kept constant.

The two chief characteristics of the Gibbs method are the consideration of the state of a system rather than a process, and the splitting of the consideration of the state of a complex system into the study of the chemical potentials of its individual components. The chemical potential has the characteristic properties of potentials such as the gravitational, electrical or magnetic potential. However, many of us are more familiar with it under other names or with related quantities which emphasize other characteristics. The partial molal free energy of a substance is its chemical potential per mole. The pH is the chemical potential per mole of the hydrogen ion divided by minus 2.3 RT. The osmotic coefficient of a solution is the chemical potential of the solvent divided by minus RT times the moles of solutes per mole of solvent. The activity of a substance is e with the chemical potential per mole divided by RT as exponent, and the activity coefficient is the activity divided by the concentration or by the mole fraction.

Gibbs's next step is to study equilibrium in an idealized system. I quote his own words:

> In order to arrive as directly as possible at the most characteristic and essential laws of chemical equilibrium, we will first give our attention to a case of the simplest kind. We will examine the conditions of equilibrium of a mass of matter of various kinds enclosed in a rigid and fixed envelope, which is impermeable to and unalterable by any of the substances enclosed, and perfectly non-conducting to heat. We will suppose that the case is not complicated by the action of gravity, or by any electrical influences, and that in the solid portions of the mass the pressure is the same in every direction. We will farther simplify the problem by supposing that the variations of the parts of the energy and entropy which depend upon the surfaces separating heterogeneous masses are so small in comparison with the variations of the parts of the energy and entropy which depend upon the quantities of these masses, that the former may be neglected by the side of the latter; in other words we will exclude the considerations which belong to the theory of capillarity.
>
> It will be observed that the supposition of a rigid and non-conducting envelope enclosing the mass under discussion involves no real loss of generality. . . . As for the other suppositions which have been made, all the circumstances and considerations which are here excluded will afterward be made the subject of special discussion.

Most of the important results associated with Gibbs's name are reached before the return to any of the excluded considerations, and the others are obtained while all but one of these considerations are still excluded. All his results are based on the assumption that there is equilibrium with respect to every possible change, and upon the count of the number of quantities necessary to describe the thermodynamic state of the system. At equilibrium and with the restrictions given by Gibbs, the energy of any phase may be expressed as a function of its entropy, volume and the quantities of its components. The partial derivatives of the energy with respect to these other functions, which are the temperature, minus the pressure, and the chemical potentials of the components, are independent of the quantity of the phase.

The phase rule needs nothing further, for it depends upon the number of independent variables and not upon the value of any of them. The application of the "Gibbs-Duhem equation," by which the chemical potential of one component can be determined if those of all the others are known, requires a knowledge of the variation of the chemical potentials with composition at constant temperature and pressure. The treatment of chemical equilibrium and of the distribution of substances between phases needs also a knowledge of the variation of the potentials with temperature and pressure at constant composition.

Equilibrium in these restricted systems is conveniently treated in terms of the Gibbs free energy, which may be defined as the sum for all the components of the products of the chemical potential by the quantity of the corresponding component. Then the conditions of equilibrium may be expressed as follows: the temperature must be the same throughout the system; the pressure must be the same except on opposite sides of a rigid membrane impermeable to at least one component; and the change in free energy must be zero for any possible change at constant temperature and pressure.

From statistical mechanics or from experimental observation, we know that the chemical potential of a substance at very low concentrations varies at constant temperature and pressure as RT times the logarithm of its concentration. Combined with the conditions for equilibrium and the thermodynamic relations for the variation of the chemical potential with temperature and pressure, this leads to all the classical expressions for chemical or physical equilibrium. For many purposes it is sufficient to know these relations and the fact that the deviations have not become large at the lowest concentrations studied experimentally. Statistical mechanics, again confirmed by experiment, gives us this assurance and at the same time furnishes the tools for a quantitative study of the deviations. It tells us that the forces between molecules cause a variation in the chemical potential of an ion which starts out proportional to the square root of the ionic strength with a coefficient determined by theory, and a variation in the chemical potential of any substance which starts out proportional to the concentration of the added substance with a coefficient which is *proportional to the interaction* between a molecule of the added substance with one of the substance under consideration, corrected for the interaction of the displaced solvent. When the two substances are the same, the ratios of these effects to the ideal solution term are proportional to the square root of the concentration or to the concentration, and are also proportional to the ratio of the interaction energy to RT. In aqueous solutions, which are of primary interest in biological chemistry, much of this interaction is due to the displacement of water, and is thus directly proportional to the volume of the solute molecule. Other interactions depend upon the number of active groups and are also usually larger for large molecules.

The restriction that electrical influences must be absent is not a serious one, for we are able to control the external electrical field and to eliminate it when we wish. The gravitational field must be taken into account for precision work. This effect is also proportional to the volume of the solute molecule and to the difference between its density and that of the medium. For a protein in water, with densities 1.33 and 1.00, the relative change in concentration per centimeter is 10^{-8} times the molecular weight. For most soluble proteins the effect is small. For viruses it is very large. The extension of this treatment to centrifugal fields, which behave like very large gravitational fields, is one of the most powerful methods for the study of large molecules.

The difficulties with large molecules increase for heterogeneous equilibrium. Since the interfacial area can be decreased by the formation of a large particle from several small ones, the solubility of a dispersed phase depends upon the size of the particles. If the shape of the particles remains constant, the effect on the chemical potential of the solute is proportional to the molal volume of the solute, and to the interfacial tension, and inversely proportional to a linear dimension of the particle. The vapor pressure of water is ten times as great from a drop 10^{-7} cm in diameter as from a plane surface. The effect of particle size on the solubility of salts indicates that the interfacial tension is ten to fifty times as great as the surface tension of water. Protein molecules are so large that the interfacial tension of a protein-solution surface must be very small indeed if the effect of particle size does not persist to particles of the size usually used for solubility measurements. The concentration at an interface of a substance which reduces the interfacial tension is proportional to the change in surface tension per mole of solute, and thus proportional to the number of surface active groups per molecule which can reach the surface. Surface denaturation is apparently due to the disruptive flattening of a globular molecule so that more groups can reach the interface. The importance of absorption at interfaces in biological systems must be extremely great.

If one of the phases is solid, the effect of strain, which causes the pressure to be different in different directions, is usually greater for large molecules than for small because the strain per molecule is greater and also because there is a smaller probability that the larger molecules can adjust themselves to relieve the strain.

Perhaps the most important difference between real systems and the idealized ones of Gibbs is that real systems are seldom truly at equilibrium. This is obviously true of biological systems, but it is also true of most of the inanimate systems we study. Although we talk often of the absoluteness of thermodynamic equilibrium, we usually assume in practice that the equations for equilibrium hold if the system is at equilibrium with respect to the change we are studying and there is no closely related change progressing rapidly. The only excuse I can find for this assumption is that it appears to work. I quote Gibbs again, this time from his letter to Bancroft:

> The meagreness of the results obtained in my E. H. S. [Equilibrium of Heterogeneous Substances] in the matter of electrolysis has a deeper reason than the difficulty of the evaluation of potentials.
>
> In the first place, cases of true equilibrium (even for open circuit) are quite exceptional. Thus the single case of unequal concentration of the electrolyte can not be one of equilibrium since the process of diffusion can not be stopped. Cases in which equilibrium does not subsist were formally excluded by my subject, and indeed could not be satisfactorily treated without the introduction of new ideas quite foreign to those necessary for the treatment of equilibrium.
>
> Again, the consideration of the electrical potential in the electrolyte, and especially the consideration of the

difference of potential in electrolyte and electrode, involves the consideration of quantities of which we have no apparent means of physical measurement, while the difference of potential in "pieces of metal of the same kind attached to the electrodes" is exactly one of the things which we can and do measure.

The case of unequal concentration of the electrolyte, or a concentration cell with transference, is a cell in which two identical electrodes are immersed in solutions of the same electrolyte at different concentrations, the solutions meeting at a liquid junction. The passage of current effects exactly the same change of state as diffusion, or its reverse. Yet electromotive force measurements may be made very accurately, and the chemical potentials determined from them agree excellently with those by other methods. A slight effect of a very sharp concentration gradient was first noted by Buehrer and me with hydrochloric acid cells. We attributed the effect to a change in temperature due to the heat of dilution by diffusion. Our explanation was confirmed by Hamer's work with sulfuric acid, for which concentrations may be chosen to make the heat effect either very large or zero, and the magnitude of the electrical effect depends entirely on the magnitude of the heat effect. The fact that an irreversible process giving the same change of state as the reversible process affects the measurement of the chemical potential only as it affects the temperature is the best justification I know for our use of equilibrium thermodynamics in systems which are not in equilibrium with respect to all processes.

An extreme example is the quasi-thermodynamic treatment of the rates of chemical reactions, based on Brönsted's theory of the critical complex. It assumes that the rate of a reaction is proportional to the concentration of an intermediate critical complex which decomposes so rapidly that it almost always forms the products if it is made from the reactants and almost always forms the reactants if it is made from the products. It is so unstable that its concentration can not be measured, but the effect of changes in the medium on the reaction rate can be determined by calculating from the theories of statistical mechanics its activity coefficient and those of the reactants. The success of this treatment is very nearly the same as that of the application of the same theories of statistical mechanics to chemical or physical equilibrium in stable systems.

The properties of a system which is not at equilibrium depend upon more variables than those of a system at equilibrium, for they must depend also upon the extent of every change of state which is not at equilibrium. These changes include: chemical reactions, which may be either homogeneous or heterogeneous; changes of concentration within a phase, between two phases or at an interface; changes of particle size in a dispersed phase, which may be solid, liquid or gas; changes of orientation relative to an external field, relative to an interface, or relative to other molecules in a solid or in a liquid crystal; and changes of crystal systems, changes of shape or changes of strain in a solid phase. If the extent of the change can be measured it is possible to treat the system as though it were at equilibrium at any stage of the change. Otherwise we assume that the system has had time to reach equilibrium. The time necessary to reach substantially the equilibrium state will vary enormously for different changes and different systems. It is much larger for many biological systems than for most of the systems studied by physical chemists. Each extension should be tested to ensure that the times are sufficient.

If my talk should persuade you to read Gibbs, you will note that many of his expressions contain an inequality as well as the equality I have discussed. This inequality covers the case in which a component is entirely absent from a phase which is in equilibrium with another phase which contains that component. Then we can only say that the chemical potential of the substance in the phase in which it is absent is equal to or greater than its potential in the rest of the system. For substances whose behavior approaches the perfect gas law or Henry's law at zero concentration, the chemical potential is minus infinity at zero concentration, and is therefore certainly less than its potential in any phase where the concentration is finite. Either it is impossible to have a component entirely absent from a phase in equilibrium with a phase in which it is present or its potential must behave very differently in such a phase and in one in which the substance can be present. Though most of us find the first assumption more reasonable, there seems no possibility of a direct answer to this problem. We may, however, define a component as practically absent from a phase if its concentration is so small that we can not measure it or its effect on the chemical potential of any other component by the methods we are using to study the system. By this criterion we often find a component practically absent from a phase in equilibrium with another phase in which it is present.

Too great insistence on thermodynamic rigor is not always helpful. I think it has hurt one important aspect of applied physical chemistry—the measurement of hydrogen-ion activity or pH. Most physical chemists have never liked the saturated potassium chloride bridge system for two reasons. They believe it is not accurate experimentally and not rigorous theoretically. It is certainly easy to make inexact measurements of pH by this method, and there must be thousands such made every day. I believe, however, that the experimental uncertainty due to the liquid junction potential can usually be reduced below the uncertainty due to the electrode just as in a simple concentration cell. The important factor is probably the heat effect at the liquid boundary, which I discussed above. The broad junction developed by Clark diminishes the disturbance, but not always enough to make up for the increase in the difference between the two solutions. Thermostating of the junction with liquid to give a large thermal capacity should greatly decrease the experimental difficulty. I think that the same amount of care would give as great precision with the salt bridge cell as with the cell with a silver chloride electrode and added chloride for the determination of acid and base dissociation constants by extrapolation to zero concentration. Effects which start out proportional to the square root of the ionic strength are only half as large for the salt bridge cell.

The theoretical difficulty lies in the fact that we can not measure the chemical potential or the activity of a single ion species. This is closely related to the fact that there is no rigorous definition of electrical potential difference between two different media as noted in the last paragraph quoted from Gibbs. Such difficulties are not new in thermodynamics. We can not determine the enthalpy or heat content of any substance, but we can measure the difference of enthalpy corresponding to a given change of state. So we have agreed on the arbitrary definition that the enthalpy shall be zero for each element and for the hydrogen ion in water, each in its standard state. The inclusion of the hydrogen ion takes care of the fact that we can not measure the properties of any single ion species. The standard free energies, or chemical potentials, are defined by a similar arbitrary definition. The standard molal electrode potentials require an arbitrary definition only for hydrogen and for the hydrogen ion in water, but not for the other elements.

We need an arbitrary definition of the variation of one single ion activity with changes in the medium. Various definitions have been proposed, but the physical chemists have not been able to come to an agreement in this matter. For simple solutions the best proposed so far is the extension of Brönsted's theory of specific ion interaction which, for electrolytes with univalent ions, states that in a pure salt the activity coefficients of the two ions are equal, and that in salt mixtures of constant total concentration the logarithm of the activity coefficient of any ion is a linear function of the concentrations of ions of the opposite sign, but is independent of the concentrations of ions of the same sign. The theory for more complex electrolytes is just as definite but not so simple to state. This definition gives a means of calculating single ion activities in simple solutions of known composition, but it does not give any means of measuring single ion activities.

A definition which is much more generally useful is that at constant temperature the electromotive force of a cell made up of a hydrogen electrode in the solution under consideration, a saturated potassium chloride bridge, and a constant electrode measures the chemical potential of the hydrogen ion in the solution under consideration. Then the replacement of the hydrogen electrode by any other electrode will give a measure of the chemical potentials of the substances reacting at that electrode. Such a definition does not contradict any measurements or theories which do not involve single ion activities. If the molal electrode potential for the cell with hydrogen electrode is so chosen that the activity of the hydrogen ion approaches its concentration in one extremely dilute solution, the same relation will hold in all dilute solutions for the hydrogen ion and also for any other ion. This definition gives no deviations from the logarithmic term proportional to the square root of the concentration. We should be able to calculate the change in potential of this cell with changing salt concentration to terms proportional to the salt concentration. Some of my early work indicates that at moderate concentrations there is a contradiction between this definition and that of Brönsted for hydrochloric acid solutions, but the contradiction is probably not serious. There is much experimental work which indicates that the definition is not a useful one for solutions very concentrated in a non-electrolyte, in which the solvent may be regarded as changed. Such solutions also offer experimental difficulties which make the application more difficult as well as less useful.

I do not believe that anything I can say about hydrogen ion activity measurements will either increase or decrease the use of such measurements or change the technique of routine work. I do hope that what I have said will reduce the sense of inferiority, which has become almost a complex, and will thus increase the precision of this type of measurement when the system and the problem justify such precision.

The definition of the hydrogen ion activity also makes the cell with inert electrode and salt bridge give a direct measure of the oxidation-reduction potential, which may be considered a measure of the chemical potential of the electron. The complications which arise when oxidation-reduction reactions will not proceed rapidly at the electrode except with catalysts have played such an important part in the study of these potentials that they need no emphasis here.

These two equilibria involve two substances, protons and electrons, which *exist in ordinary solutions* only at extremely minute concentrations, but which still attain equilibrium with the rest of the system rapidly. Another very important equilibrium involves water, the most abundant component of biological systems, which appears able to go from one part of the body to another so rapidly that minute changes in its chemical potential are important. The activity of water in our blood is only about half a per cent. less than in pure water and only about two thousandths of a per cent. less than in its ultrafiltrate. Yet the balance in a biological system appears to depend upon a small fraction of the latter difference, which corresponds to the effect of a pressure of twenty-five millimeters of mercury. Even the simplest system of interest to the biological chemist is a very complicated one for accurate thinking. To improve over the *ideal solution treatment* developed by van't Hoff and Donnan, it is necessary to keep very clear the distinction between activity coefficients and osmotic coefficient and not to forget which variables are being maintained constant. This is also one of the cases in which second approximations partially cancel each other so that the first approximation is much better than a treatment which uses the second approximation in one part but the first in another.

The distributions of many other substances throughout the body make some of the most interesting and probably the most important problems of biological chemistry. Not all can have the same chemical potential *throughout, but the first step in the study* must be the determination of how far the actual distribution varies from the equilibrium distribution because of impermeability, slow permeability or other cause. The rest of the problem will require knowledge outside of thermodynamics, although there will be no violation of thermodynamic laws. For two examples, it would be very valuable to know how closely two changes of state must be coupled so that a decrease in free energy in one may compensate for an increase in free energy in the other, and also what concentration gradients are produced by a temperature gradient which is maintained constant in spite of flow of heat.

The details of a review of this kind are essentially personal and subjective. The examples are mostly taken from protein chemistry, partly because I believe it important, but largely because I am less ignorant of protein chemistry than of the other branches of biological chemistry. I have called attention to those applications of thermodynamics which I believe need more careful scrutiny and to another application of which my opinion is much higher than those of most physical chemists. Yet it would be unfortunate if this question should become one of my authority against that of my colleagues. The most important part of my contribution is impersonal and objective. It is the reminder that each new application can and must be thoroughly tested without regard to the name associated with it.

THE TRAINING OF BIOLOGISTS[1]

By Professor **PAUL WEISS**

THE UNIVERSITY OF CHICAGO

A few comments to introduce our topic may seem appropriate. Why this conference on the Training of Biologists? Well, simply because by shaping future biologists, we shape the future of biology. And there seem to be some grounds for concern. The question is: Can we profitably consider the many ramifications of a *training program* in biology without having a unified concept of *Biology* itself? There is our cardinal issue: What *is* biology, and what would we want it to be like? If we accord to biology the dignity of an integrated, consistent and coherent science, rather than view it merely—if you pardon the irreverent figure of speech—as a holding company embracing numerous separate and independent enterprises, then a clear understanding about the substance, aims and limits of this science would help to establish a sort of central beacon with regard to which we could orient ourselves, when dealing with subordinate issues. Then, anybody's problem becomes everybody's concern, and the common ground for this meeting of representatives of diverse interests is satisfactorily circumscribed.

Our meeting seems timely, or even overdue, in view of world events. In this world crisis, science finds itself confronted with mounting short-range demands and an altered long-range outlook. All around we hear it being predicted, that after this crisis has come to pass—in fact, if it is to be overcome for good—this world can never be the same again; and that, if the change is to be for the better, the critical, disciplined, fact- and relation-conscious mind of the scientist will have to be accorded a major share in the improvement.

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[1] Address by the Chairman of the Conference on the Training of Biologists, held in connection with the Fiftieth Anniversary Celebration of The University of Chicago on September 18–20. A full report of the proceedings of the conference will be published at a later date. Aid by the Carnegie Corporation of New York is gratefully acknowledged.

If experience and reason are to gain the ascendancy over emotion and superstition in the conduct of human affairs, man will have to know more about man, and then live up to his knowledge. Since for much of this knowledge he will have to call on biology, it becomes our responsibility to provide a generation of biologists fit to answer the call.

Only partly will their fitness depend on biological competence. Unless they are also made conscious of their obligation to society, they will, I am afraid, be at a loss to justify their subsidized existence to a society asking uncomfortable questions. As the support of science will become incumbent on increasingly broader strata of society, for reasons of which you are aware, more and more such questions will be asked. And the biologist will have to be convincing in showing cause why what he is doing should not be discontinued as a publicly supported enterprise. The research man must prove that his work is more than a glorified hobby, the teacher that he is more than a slow-motion rendition of a text; the practicing biologist being the only one who will be taken for granted because of the plausibility of his utilitarian value.

Now, it is somewhat alarming to have to think of the possibility that in some future attempts might be made to set up an authoritarian agency to sit in judgment, and exert control, over what a scientist should or should not do or teach. Science would choke in such an atmosphere. But it is just as alarming to think of what would happen if the coming generation were left with the illusion that society will continue to stand for the random movements of unoriented and confused minds, privileged to receive public support for their playful exertions, good or no good, just because the story goes that a blind hen, too, occasionally finds a grain. Presumably, an economically minded society would withdraw its support from what it considers a bad investment, and science would be starved. It is up to us to avert both these dangers of either thus choking or starving our science.

We can do this, I submit, by waking up our students to the realization that their privilege of carrying on science as a public trust carries responsibilities. Heighten their sense of responsibility, and they will all by themselves check and recheck their conduct and activities by the standards of scientific and social ethics of which they will have been made conscious; and they will give a good account of themselves under any enlightened scrutiny. But keep on leaving them in the dark, and the whole structure of science will suffer.

This is not advocating indoctrination, but merely a better and more explicit exposition before the student of the philosophic, historical, methodological and cultural foundations of his science, than he is commonly offered. He ought to learn not only how to do things, but also how to rate the results of his doings, so that he may intelligently chart his course, ever on guard against the blind alleys of wasteful monomaniac pursuits. He should learn what his science is all about, how it has grown and how it might be made to grow even better, and what he might contribute to that end. He must learn to plan his activities in teaching and research so that they will furnish useful contributions to the organic growth of integrated knowledge, rather than mere punchcards in an enormous filing system.

So long as science was a pioneering adventure of only a few treks into vast terra incognita, there could be unlimited freedom of movement. With science becoming more and more a proposition of mass team work, some sort of traffic control becomes necessary, and we would rather see this come about through the self-control of drivers properly instructed in their responsibilities than by the equivalent of police enforcement. If we unfold before the students the whole plan of that campaign for the conquest of nature that is science, rather than simply teach them how to handle the weapons in that campaign, we shall enable the better ones to pick all by themselves strategic positions of greatest promise of advancement to science, and the less gifted ones, at least, to do with greater understanding what they are called upon to do.

Now, here I feel lies our first duty. If we are to give the student insight into the plan of this campaign that is science, we must first know the plan ourselves. But do we have one? Are we agreed on how best to serve the progress of biology, is there unity behind our purpose and consensus on procedure? To answer these questions is well within the province of this meeting. Unless we succeed in answering them to our mutual satisfaction, we shall have to keep temporizing with the various partial issues of our educational program, which it would be so infinitely easier to deal with as part and parcel of a single broad fundamental policy. It will have to be our task, therefore, to see whether we can agree on certain common programmatic principles.

Let us take an example: the rating, in both teaching and research, of *facts,* as against *principles.* Or, as I would prefer to state the issue: information *vs.* knowledge. This issue has been amply argued with much verbiage, some wisdom and little consequence. Some of us undoubtedly have strong convictions in the matter, and we shall differ in our views. We may or may not be able to reconcile them. But at any rate, the eventual turn of the argument will necessarily influence all such matters of policy as, for instance, whether students should be made to dissect more specimens or more concepts.

The way I see it, the relation between factual data and knowledge is the same as that between food and a growing organism. Like food, so-called pure facts must be digested, resorbed and assimilated in order to become knowledge; and unless they are, they become wastes. Already the hoard of unconsumed facts has become so enormous that to point—by way of alibi—to their possible utility in some future, sounds no longer convincing; if ever their time should come, they will long have become obsolete, if not altogether forgotten. This applies to unrelated facts of research as well as to unrelated data in teaching.

Now, the question is obviously not whether we should teach facts and techniques *or* principles and concepts, but rather what proportion of the student's time and energies we should allocate to the ingestion of facts on the one hand, and their digestion on the other, given a certain educational aim and a definite time limit for its attainment. It seems that, instead of letting these proportions be decided by individual preferences, institutional traditions, technical expediency and sheer accident, we might find some more pertinent formula of apportionment.

It will be the same with most of our other problems: Proportions and not volume will be the main issue. It would be idle to indulge in dreams of what volume of knowledge we, preoccupied as we are with our individual fields of specialization, would like to communicate to our students, if we had not to compete for their time, interest, endurance and resorptive capacity. The volume of instruction will always be limited by the hard reality of restricted facilities and human nature. But even though its volume may have to vary widely, the proportions of any program may be preserved without distortion. It is on these proportions, on the harmony of the educational program, that we should insist. This implies that in apportioning subject matters, attention will have to be paid not only to their factual content, but likewise to their potential value in developing those faculties which transform a student of biology into a biologist. Any carefully conceived program will have to strike a sound balance between attention to detail and generalization; between observation and experiment; analytical acumen and broad perspective; intellectual mastery and manual craftsmanship; mental stability and critical acumen; respect for tradition and courage to break it when necessary for progress; and so on. It should be easier to find our way through this maze of concrete problems with a central objective in view as our directive, than if we continued to drift apart along our various lines of specialization. Gathered here, therefore, as we are from those various lines, we may attempt to reweave a solid fabric of general biology out of the dangerously separating threads of departmentalization.

If, after these five sessions, we shall part with some clarification of purpose as guide for future action, this is all the reward we may duly expect to come from this venture. If, in addition, our collective opinion should turn out to point a way as to how to translate our conclusions into concrete action, so much the better.

ANNIVERSARY ADDRESS OF THE PRESIDENT OF THE ROYAL SOCIETY[1]

By Sir HENRY DALE

DIRECTOR OF THE NATIONAL INSTITUTE FOR MEDICAL RESEARCH

As we come to the end of another year we can see, as yet, no prospect for science of escape from urgent preoccupation with the means of waging war. On the contrary, with the Union of Soviet Russia now locked in a supreme struggle for its own existence and the world's freedom, and with the United States of America rapidly directing its tremendous scientific and technical potential to the support of the same great cause, the diversion of science from its normal uses and objectives has spread right round the world. Yet even this grim necessity has brought with it some measure of compensation, in drawing closer the bonds of friendship, between the men of science in the countries thus united in a common purpose. We in Britain received a tremendous encouragement in the early months of this year, from the visit of President Conant and his associates to establish here, in London, an office for the maintenance of regular and intimate cooperation, between the war researches of our American colleagues and those which are here in hand. More recently, and in spite of all difficulties of communication, the sense of a common peril and a common determination is bringing us into a new and growing intimacy of collaboration with our colleagues of Soviet Russia. The organization of the science of the British Empire for war has brought to London already a number of distinguished colleagues from the Overseas Dominions, and we have heard of others who are on the way. It has been a particular pleasure to gather them here, in the house of the Royal Society, and to invite them to regard it as a center and a rallying point for discussion of the means by which this new and closer collaboration, arising under the stimulus and the necessity of war, may be perpetuated and strengthened for the purposes of peace.

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[1] Concluding part of the address given at Burlington House, London, on November 11, 1941.

Generous gifts to the society, during the year, from sister societies in America, have given further welcome evidence of the determination of our colleagues there to come to the help of British science in this time of need. The American Philosophical Society, founded in 1743 by Benjamin Franklin, with this society as his model, sent us ten thousand dollars "for the aid of science in Britain." They have confirmed our interpretation of their fraternal gift, as betokening a desire to help us to preserve some measure of normal scientific activity in this country during the war, and to keep alive the tradition of a free pursuit of knowledge for the benefit of all men. We have been able to find good use already for a large part of this benefaction, in the maintenance of a number of important researches, which war conditions had threatened to interrupt or to bring to an end. The American Physiological Society similarly sent us five thousand dollars, as a spontaneous contribution, to the support of scientific publication in Britain, mentioning physiology as the subject to which they, as physiologists, desired us to give the first consideration. The Rockefeller Foundation, that truly international benefactor and promoter of natural knowledge, had already asked us to be responsible for the distribution of twelve thousand five hundred dollars in aid of scientific publication in Britain in these difficult times.

As I have taken occasion earlier to state, gifts such as these, welcome for their own intrinsic value and for the practical uses which we are readily finding for them, are even more welcome on account of the evidence that they bring, of the feeling of comradeship between our American colleagues and ourselves. We can do no less, I think, than assure them of our determination that this closer sense of unity in aims and ideals, with them as with our fellow citizens of the British Overseas Dominions, shall not be lost, but rather strengthened, when we face together the new problems which the end of the war will bring.

Though the first and imperative call on the science of all free countries is for the means of winning the war, to save the freedom without which science can not in any true sense survive, we can not put aside the duty of preparing for the part which science must play, in rebuilding and maintaining civilization when peace returns. The conference recently organized by the British Association, on "Science and the World Order," attracted more attention from the press and the public than is usually given to scientific events and discussions; and it was, indeed, an impressive and significant fact that men of science from a dozen or more different countries, some far distant, should have found it possible now to meet, here in our war-scarred London, and to find the time and the impulse for such debate. We may offer our very sincere congratulations on the success of such an enterprise. Many who took part in these meetings, held at a time when science finds itself conscript and organized as never before, for the destructive purposes of war, were clearly ready to support the view that it should be as fully organized by the governments of a world at peace, for its proper purposes of enriching life and enlarging the opportunities of happiness for all men alike. There were not wanting voices, however, such as that of our biological secretary, to sound a warning of dangers which might be entailed, by such fulness of association between science and government as others were advocating with conviction and enthusiasm. Freedom and opportunity, it was pointed out, rather than organization, provide the conditions for the highest types of research, and thus, in the end, for the greatest services which science can give to mankind. I find myself in sympathy with this view, and nobody here, I think, would suggest that it is usually possible to organize the researches which advance boldly into the unknown, and open new vistas to human understanding. Here we shall certainly not overlook the fact that, in the period between the two wars, important funds have been placed at the disposal of the Royal Society by a series of generous benefactors, to be administered for the support of researches over a wide range of subjects, in complete independence of any control by the state.

On the other hand, I think that it will be agreed that the remarkable development in this country, since 1914, of the state support of research administered by the three advisory councils, normally in relation to the needs and the activities of a nation at peace, has taken place without any obvious detriment or danger to the freedom of science. The Royal Society's former function, of advising the government directly on all scientific matters, and of organizing such systematic researches as were then undertaken in the public interest, has, of necessity, been shared and greatly diminished. We as a society, however, can fairly regard this development as, in many respects, a realization of the plans and the dreams of our predecessors here; and I do not think it fanciful to claim that our society's traditions and standards have been still effective, through the influence of our fellows on the advisory councils and their committees, and through the filling of their chief executive offices by men of our fellowship. As a whole-time research worker myself, since 1914, under the body which became the Medical Research Council, and the senior now in that service, I can bear grateful witness to the freedom of opportunity which can exist under an enlightened organization and control, exercised on behalf of the government. I have no reason to suppose that the conditions are otherwise under the other research councils. Nor should we lose sight of the fact that a further large proportion of the free scientific research of the country is now indebted to support from the state through grants to the universities, administered without any trace of detailed government control.

While, therefore, the existing mechanisms for the support of science by the state are doubtless susceptible of improvement at one point or another, I find no reason to fear any threat to the freedom of science from them, or from any natural development on those lines. Nor do I fear it from a wider use of the organized application of science and scientific method to problems of public welfare; nor, again, from a more effective access of scientific knowledge to those responsible for government. A year ago Sir William Bragg told the society of the formation of the Scientific Advisory Committee to the War Cabinet, under the chairmanship of Lord Hankey, with the president and two secretaries of this society as members *ex officio*. The representation of the society has, indeed, been strengthened since then, and in a manner most welcome, by the fact that, though I have succeeded him *ex officio,* Sir William Bragg still gives his wisdom and experience to the work of that committee, as an extra member.

There is one direction, however, in which I do find some reason to fear for the freedom of science. If science should become entangled in controversial politics, through the over-eagerness of its advocates and champions to invoke the sanction of science, or to claim its potentialities, in support of any special political doctrine, then indeed I believe that the threat to its freedom might become a real danger. Let there be no misunderstanding of my meaning. I am not abusing the privilege of this chair by using "controversial" as an epithet, to be applied to political opinions which I do not happen to share. I see danger if the name of science, or the very cause of its freedom, should become involved as a battle cry in a campaign on behalf of any political system, whether its opponents would describe it as revolutionary or reactionary. If science were allowed thus to be used as a weapon of political pressure, it would be impossible to protect science itself eventually from the pressure of sectional politics. If that should happen the dangers are, I believe, beyond dispute—the danger, for example, that fundamental researches, having no immediately practical appeal, would be allowed to fall into arrears through relative neglect; or the danger that the rigid standards of true science would be relaxed, by allowing the convenience of results for policy or for propaganda to enter into the assessment of their validity as evidence. This society, with its firm and unbroken tradition of complete aloofness from political controversy, may still find it an important part of its function, to keep watch and, if necessary, to stand without compromise, for the right and the duty of science to seek the truth for its own sake, in complete freedom from any kind of extraneous influence. I hope, indeed, that there will never be need thus to invoke our tradition, to protect the freedom and the integrity of science from the enthusiasm and the advocacy of any of its friends.

OBITUARY

FREDERICK HUTTON GETMAN

DR. FREDERICK HUTTON GETMAN, physical chemist, died suddenly on December 2, 1941, at the Stamford Hospital in Stamford, Conn. He had been in failing health for several months but in September attended the meeting of the American Chemical Society in Atlantic City, where he presented a paper.

He was born in Oswego, N. Y., on February 9, 1877. He was the son of Charles Henry and Alice (Peake) Getman. The family had a very considerable fortune, made in the lumber business, and young Getman had an assured position in business if he chose to follow his father's calling. However, his natural inclinations were along other lines. He early developed a taste for music, which remained with him throughout life. He was an excellent organist. Just when he decided to make science his major interest in life is not known to the writer, whether it was under Mallet or Remsen; but we have his own testimony of his love and admiration for the latter. He was educated at Rensselaer Polytechnic Institute, Lehigh University and the Department of Chemistry at the University of Virginia, from which he graduated in 1896. He was an instructor in chemistry and physics in the Stamford High School from 1897–1901. He then went to the Johns Hopkins University, where he received his doctorate in physical chemistry in 1903. He was fellow in physical chemistry at the Johns Hopkins University from 1901 to 1903 but remained as fellow by courtesy during the following year. He then became Carnegie research assistant for the year 1903–1904. Dr. Getman's first position after leaving the Johns Hopkins was as lecturer in physical chemistry at the College of the City of New York. He was then lecturer at Columbia University in physics from 1907 to 1908. In 1909 he became associate professor in chemistry at Bryn Mawr College, where he remained for six years.

The need for his counsel at Stamford in his father's business became so pressing that he then decided to change his base to Stamford, although continuing his scientific interests. He took an increasing responsibility in the Getman and Judd Company, of which he became vice-president, but at the same time he built and equipped the Hillside Laboratory, of which he was the director.

Dr. Getman's researches were begun with Dr. Harry C. Jones on the subject of "Hydration in Solution." They achieved notable results from their study of the freezing points of solutions. At Bryn Mawr Dr. Getman continued his work on solutions, making a study of the viscosity of various solutions. At Stamford he installed refractometric and spectroscopic equipment for the study of solutions. Later work was devoted to electrode potentials and chemical activity. The titles of his various papers taken from *Chemical Abstracts* are much too numerous to give in detail.

Dr. Getman was author of several books, of which two will be referred to here. His "Outlines of Physical Chemistry," of late years in cooperation with Dr. Daniels, has gone through many editions and has been a standard text-book in American colleges for nearly a generation, excelling in clarity, conciseness and scholarship. His "Life of Remsen" was published by the *Journal of Chemical Education* as a pioneering effort in the publication of the lives of American chemists. Dr. Getman was engaged at the time of his death in securing the material for the publication of the lives of other American chemists. It is hoped that this work may be continued in other hands.

The broad interests of Dr. Getman are indicated by the fact that he was director of the Stamford Hospital, the Stamford Trust Company, the Ferguson Library and president of the Stamford Symphony Society. On trips in the West he transcribed some of the songs of the American Indians which he worked over into themes suitable for performance by orchestras. He was also active in the Presbyterian Church of Stamford. On November 26, 1906, he married Miss Ellen M. Holbrook, of Plymouth, Mass., who survives him.

EUGENE C. BINGHAM

LAFAYETTE COLLEGE

RECENT DEATHS

DR. ALEXANDER LOWY, professor of organic chemistry at the University of Pittsburgh, died on December 25 at the age of fifty-two years.

DR. LEON PRATT ALFORD, professor of administrative engineering at New York University, chairman of the department of industrial engineering, died on January 2 at the age of sixty-five years.

JOHN W. KIDD, dean of the School of Engineering of the Texas College of Mines at El Paso, died on December 29. He was sixty years old.

J. H. RILEY, associate curator in the Division of Birds of the U. S. National Museum, died on December 17. Mr. Riley had been associated with the division since 1896.

SCIENTIFIC EVENTS

DEVELOPMENTS IN AGRICULTURAL RESEARCH IN GREAT BRITAIN[1]

THE extended field of activity and additional financial resources which have recently been granted by the government to the Agricultural Research Council have opened the door to new developments in this branch of applied science. A large part of the council's activities will still be devoted to coordinating, and advising on, the work of the various research institutes to which the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland are making maintenance grants, and to furthering the interests of these institutes in every possible way; but it is the council's intention to devote some part of the funds to be expended at its own discretion, for which it is answerable to the Lord President of the Council, to the furtherance of agricultural research in university departments and to the enlargement of its own scientific staff. It is, in particular, the council's desire to encourage both senior and junior research workers in the biological sciences to enter the agricultural field. In pursuance of this policy, the council has established two new research units under its direct control, a Unit of Animal Physiology and a Unit of Soil Enzyme Chemistry.

The Unit of Animal Physiology will be under the direction of Sir Joseph Barcroft, with the assistance of Mr. A. T. Phillipson and Dr. R. A. McAnally. This unit will, by agreement with Professor E. D. Adrian, be housed in the Department of Physiology at Cambridge, and will work in close liaison with the Institute of Animal Pathology and the Institute of Animal Nutrition. In the first instance, the staff of this unit will devote a large part of their time to the study of ruminant digestion. The Unit of Soil Enzyme Chemistry will be under the direction of Dr. J. H. Quastel, assisted by Dr. P. J. G. Mann and D. M. Webley. By agreement with Sir John Russell, this unit will be housed in the Rothamsted Experimental Station. Dr. Quastel and his staff will, in the first instance, be engaged mainly in the study of the influence on soil fertility of enzyme systems derived from soil bacteria, or from other microorganisms.

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[1] *Nature.*

COMMITTEE ON ECONOMIC TRENDS OF THE INDUSTRIAL RESEARCH INSTITUTE

IN a survey of "Science in Industry" in 1941, Dr. Maurice Holland announces that recently the Industrial Research Institute (affiliated with the National Research Council) representing more than forty companies in varied fields of industry, known as leaders in technology in their fields, have appointed a committee on "Economic, Political, and Social Trends Affecting Research Policies" to study the deep and significant national trends in these three categories as they are now affecting and may affect in the future research personnel, organization and appropriations.

The primary purpose of the committee is to devise ways and means to preserve research organizations intact after the war. It is looking toward the formulation of a plan which can be sponsored and backed by the only organized industrial company membership group in the United States for some form or method of accumulating a surplus or sinking fund for research in lean times, or some form of economic security such as irrevocable trust funds for research workers, or some form of group insurance especially designed to fit the needs of creative workers in industry.

The report points out that "with the appointment of Dr. Vannevar Bush as director of the Office of Scientific Research and Development, the entire science resources of the nation, including those of the armed services, are now under the direction of one man. For the first time in the nation's scientific history the resources of government, industry and university are integrated and coordinated for the primary purpose of national defense.

"Substitution of industrial materials come second on the list as a significant trend in the defense-dominated scene—with companies crossing industry boundaries. The search for substitute material in the case of at least one large automobile manufacturer has definitely indicated that the substitute material is functionally better adapted to the purpose, is cheaper and more decorative, with the result that they will probably not go back to the original material.

"The publication of 'Industrial Research. II. A National Resource' by the National Resources Board—a survey made by the National Research Council for that body—has had a marked effect in high places in industry and industrial-financial groups in stimulating interest in technical research as one form of 'industrial insurance.' This is particularly true in the management and executive strata of industry and financial organizations."

THE COOPERATIVE COMMITTEE ON SCIENCE TEACHING

UNDER the sponsorship of five scientific societies representing biology, chemistry, mathematics, physics and research in science teaching a committee has been formed to work on educational problems of vital interest to all science teachers which no single organization can solve working alone. The committee is known as the Cooperative Committee on Science Teaching.

Two meetings have been held, one in April and one in November, 1941. Work is now in progress on four problems:

1. Licensing or certification of secondary-school science teachers. The committee hopes to work out a solution that will be practicable and that will be adopted by certification authorities.
2. The college training of prospective science teachers. It is desirable to prepare teachers for teaching certain combinations of subjects rather than to prepare intensively in one subject.
3. Exploratory studies of the secondary-school science curriculum. The committee hopes to stimulate a number of colleges and universities to organize workshops and conferences for bringing together secondary-school teachers to work on their educational problems.
4. Problems of state or local agencies needing the services of educational consultants on questions pertaining to science teaching. The committee offers its services as a consultant to state or local agencies working on problems pertaining to science teaching.

The committee consists of the following members:

Representing the American Association of Physics Teachers: K. Lark-Horovitz, Purdue University; Glen W. Warner, Wilson Junior College, Chicago.

Representing the American Chemical Society: B. S. Hopkins, University of Illinois; Martin V. McGill, Lorain High School, Lorain, Ohio.

Representing the Mathematical Association of America: A. A. Bennett, Brown University; Raleigh Schorling, University of Michigan.

Representing the National Association for Research in Science Teaching: G. P. Cahoon, the Ohio State University; Robert J. Havighurst, University of Chicago.

Representing the Union of Biological Societies: Oscar Riddle, Carnegie Station for Experimental Evolution.

Robert J. Havighurst is chairman of the committee and Glen W. Warner is secretary.

THE AMERICAN FERN SOCIETY

DR. DOUGLAS HOUGHTON CAMPBELL, of Stanford University, has recently (December, 1941) been elected to honorary membership in the American Fern

Society. Dr. Campbell, who has been a regular member of the society for twenty-five years, becomes the fifth botanist to receive this honor during the fifty years' existence of the society, the others being Dr. Carl Christensen, of Denmark; Professor Frederick Orpen Bower, of England; Professor Willard Nelson Clute, of Butler University, Indiana, and Dr. Campbell E. Waters, of Washington. Professor Campbell began his fern work with a research problem on the common sensitive fern, Onoclea, fifty years ago.

The American Fern Society is about to celebrate fifty years of activity relating to ferns. While its official organization and first publication date from 1893, forty-nine years ago, there had been a preliminary gestational period of a year or two before that, during which its nineteen charter members perfected the plans which led to its birth as the "Linnaean Fern Chapter" of the Agassiz Association, and later to an adolescent change into "The American Fern Society." Drs. Waters and Clute have been members for half a century.

From its start with nineteen charter members, the Fern Society has grown to a present membership of over four hundred, comprising fern students from many different professions and walks of life. During 1941, the society's publication, the *American Fern Journal*, completed its thirty-first volume with Dr. W. R. Maxon, of the Smithsonian Institution, as its editor-in-chief. Preceding him, C. A. Weatherby, of the Gray Herbarium, served as editor for a period of twenty-six years. Publication headquarters of the journal are at the Brooklyn Botanic Garden, which also houses its herbarium and library. Before the *Journal* was started (1910), the society sponsored the *Fern Bulletin*, which was edited through twenty volumes by Willard N. Clute.

THE AMERICAN PHILOSOPHICAL SOCIETY

SINCE 1937 the American Philosophical Society has been holding a general meeting in the month of February, at which meetings such topics have been considered as the "Administration of Funds in Aid of Research," the "Publication of Research," "The Centenary of the Wilkes Exploring Expedition," "The Life and Work of Alexander Dallas Bache" and the "Centenary of Geomagnetism in America."

It is proposed to devote the midwinter meeting on February 13 and 14 to the "Early History of Science and Learning in America" with especial reference to the part played by the American Philosophical Society, which this year completes its bicentenary. At present the program includes the subjects and speakers given below:

Mathematics, Frederick E. Brasch, Library of Congress.

Astronomy, S. A. Mitchell, University of Virginia.

Physics, W. F. Magie, Princeton University.

Chemistry (Joseph Priestley), Detlev W. Bronk, University of Pennsylvania.

Engineering, Dugald C. Jackson, Massachusetts Institute of Technology.

Meteorology, W. J. Humphreys, U. S. Weather Bureau.

Agriculture, M. L. Wilson, under-secretary, United States Department of Agriculture.

Botany, M. L. Fernald, Harvard University.

Natural History (Benjamin Smith Barton as naturalist), Francis Pennell, Academy of Natural Sciences of Philadelphia.

Entomology, Philip P. Calvert, University of Pennsylvania.

Geology and Geophysics, Bailey Willis, Stanford University.

Paleontology, George G. Simpson, American Museum of Natural History.

Medicine, Francis R. Packard, Philadelphia.

The American Indian, Clark Wissler, American Museum of Natural History.

Education, Merle M. Odgers, Girard College.

Michaux and His French Associates, Gilbert Chinard, Princeton University.

This program should prove of unusual interest not only because of the subjects and speakers announced, but also because the theme of this meeting has been proposed as the field which should be especially cultivated by our library. This meeting should enable us to assess the present value of our library in this field and to learn of the gaps which should be filled if it is to be an important aid in this department of historical research.

As usual the society will provide hotel entertainment for non-resident members and specially invited guests.

EDWIN G. CONKLIN,
Executive Officer

OFFICERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A FULL account of the Dallas meeting of the American Association for the Advancement of Science and the scientific societies associated with it, edited by the permanent secretary, will be printed in the issue of SCIENCE for February 6.

Officers for 1942 were elected as follows:

President

Dr. Arthur H. Compton, University of Chicago.

Vice-presidents and Chairmen of the Sections

Mathematics (A): Marshall H. Stone, Harvard University.

Physics (B): A. J. Dempster, University of Chicago.

Chemistry (C): J. H. Hildebrand, University of California, Berkeley.

Astronomy (D): Edwin F. Carpenter, University of Arizona.
Geology and Geography (E): Chester R. Longwell, Yale University.
Zoological Sciences (F): W. C. Allee, University of Chicago.
Botanical Sciences (G): J. T. Buchholz, University of Illinois.
Anthropology (H): Leslie Spier, University of New Mexico.
Psychology (I): H. E. Garrett, Columbia University.
Historical and Philological Sciences (L): Morris R. Cohen, New York, N. Y.
Engineering (M): W. R. Woolrich, University of Texas, Austin, Texas.
Medical Sciences (N): H. S. Gasser, Rockefeller Institute for Medical Research, New York.
Agriculture (O): A. E. Murneek, University of Missouri.
Education (Q): Harold F. Clark, Columbia University.

Members of the Sectional Committees

Mathematics: W. L. Ayres, West Lafayette, Ind.
Chemistry: William C. Rose, University of Illinois.
Astronomy: R. M. Petrie, Dominion Observatory, Victoria, B. C.
Geology and Geography: Marland Billings, Harvard University.
Zoological Sciences: A. C. Kinsey, Indiana University.
Botanical Sciences: H. H. Bartlett, University of Michigan.
Anthropology: Clyde Kluckhorn, Harvard University.
Psychology: William A. Hunt, Newport, R. I.
Historical and Philological Sciences: Alexander Pogo, Harvard Library.
Medical Sciences: Irvine H. Page, Indianapolis City Hospital.
Agriculture: W. H. Pierre, Iowa State College.
Education: M. R. Trabue, Pennsylvania State College.

Executive Committee

Esmond R. Long, Henry Phipps Institute, Philadelphia, Pa.
W. E. Wrather, Dallas, Texas.

Council

Howard A. Meyerhoff, Smith College.
William E. Wickenden, Case School of Applied Science.

Committee on Grants

A. F. Shull, University of Michigan.
A. L. Hughes, Washington University.

SCIENTIFIC NOTES AND NEWS

Dr. Arthur H. Compton, Charles H. Swift distinguished service professor of physics at the University of Chicago, was elected president of the American Association for the Advancement of Science on December 31, at the Dallas meeting. He succeeds Dr. Irving Langmuir, of the General Electric Company.

Mountain summits in the Sequoia National Park, all more than 13,000 feet high, with the approval of the U. S. Board of Geographical Names, have been given the names of the following distinguished scientific men: Chamberlin, Hale, Newcomb and Pickering.

The annual $1,000 prize of the American Association for the Advancement of Science for a notable contribution to science presented at its annual winter meeting has been awarded to Professors Frank H. Johnson, of Princeton University, and Dugald E. S. Brown and Douglas A. Marsland, of New York University, for their paper entitled "The Reversible Denaturation of Enzymes as a Determining Factor in the Reaction of Biological Systems to Temperature and Pressure."

Dr. Alwin M. Pappenheimer, of the New York University College of Medicine, was presented on December 30 with the prize of $1,000 and a bronze medal of the Eli Lilly Company at the joint annual banquet in Baltimore of the Society of American Bacteriologists, the American Association of Immunologists and the American Society for Experimental Pathology.

The Penrose Medal of the Geological Society of America was presented to Professor Norman Levi Bowen, of the University of Chicago, at the annual dinner of the society at the Boston meeting on December 30.

The presentation of the Perkin Medal "for outstanding work in applied chemistry" to Dr. Martin Hill Ittner, chemist of the Colgate-Palmolive-Peet Company, will be made at a meeting of the Chemists Club, New York, on January 9.

Professor Douglas Johnson, of Columbia University, was elected president of the Geological Society of America on December 29 at the opening of the annual meeting in Boston. Other officers elected were: *First Vice-president,* Professor E. L. Bruce, of Queen's University, Kingston, Ont.; *Second Vice-president,* Professor Chester R. Longwell, of Yale University; *Third Vice-president,* Dr. Lloyd W. Stephenson, of the U. S. Geological Survey; *Fourth Vice-president,* Dr. Frederick E. Wright, of the Geophysical Laboratories of the Carnegie Institution; *Secretary,* Dr. H. R. Aldrich, of Columbia University. Councilors elected included past president, Professor-emeritus Charles P. Berkey, of Columbia University; Professor William O. Hotchkiss, of Rensselaer Polytechnic Institute; Dr. A. I. Levorsen, of Tulsa, Okla., and Professor Rollin T. Chamberlin, of the University of Chicago. The newly elected president, the vice-presidents and the secretary are also members of the council.

At the Baltimore meeting of the American Society of Bacteriologists, officers were elected as follows: Dr. Selman A. Waksman, of Rutgers University, *president;* Dr. Rebecca Lancefield, of the Rockefeller Institute for Medical Research, *vice-president,* and Dr. William B. Sorrels, of the University of Wisconsin, *secretary-treasurer.*

Dr. Evarts A. Graham, professor of surgery at Washington University Medical School, St. Louis, has been elected a member of the Royal Society of Sciences of Uppsala.

Dr. Otto Loewi, research professor of pharmacology at New York University College of Medicine, has been appointed Walker-Ames professor of pharmacology and physiology for the spring quarter of 1942 at the University of Washington.

Dr. Mario Soto has been appointed professor of pharmacology at the University of Buenos Aires. He will devote his time to research and will give up his clinical connections.

Dr. Bruno Nowakowski, professor of hygiene, has become a member of the faculty of the Polish School of Medicine at the University of Edinburgh.

Dr. C. E. Lucke, Stevens professor-emeritus of mechanical engineering at Columbia University, who retired this year as head of the department of mechanical engineering, has been appointed by the Chemical Construction Corporation, New York, consultant in the selection and installation of power-generating and mechanical equipment.

William C. White, engineer in charge of the vacuum tube division of the radio and television department of the General Electric Company, has been made director of an electronic laboratory which has been established by the company for the centralization of its activities in this field. He is succeeded in the vacuum tube division by O. W. Pike.

Dr. Z. I. Kertesz, chief in research in chemistry at the New York State Experiment Station at Geneva, has been granted a six months' leave of absence to engage in research on the production of various citrus products on a project sponsored by the Federal Government at Dunedin, Fla.

The American Chemical Society has announced the formation of a committee on economic status, to conduct a survey of the chemical profession in America in cooperation with the U. S. Bureau of Labor Statistics. Dr. Lawrence W. Bass, assistant director of the Mellon Institute of Industrial Research, Pittsburgh, has been made chairman.

Dr. William C. Stadie, professor of research medicine at the University of Pennsylvania, will deliver the fourth Harvey Society Lecture of the current series at the New York Academy of Medicine on January 15. He will speak on "Intermediary Metabolism in Diabetes Mellitus."

The appointment of a special committee entitled "A Committee on Wartime Requirements for Specialized Personnel" has been announced by the National Resources Planning Board. This committee will function as a part of the National Roster of Scientific and Specialized Personnel, of which Dr. Leonard Carmichael is director. The names of the committee, announced by Frederic A. Delano, chairman of the National Resources Planning Board, are: Dr. Leonard Carmichael, *chairman;* Dr. Edward C. Elliott, president, Purdue University; Marion B. Folsom, treasurer, Eastman Kodak Company; Dr. Guy Stanton Ford, ex-president, University of Minnesota; Brigadier General Lewis B. Hershey, director, Selective Service System; Edward F. McGrady, special adviser to the Secretary of War; Monseigneur John A. Ryan, National Catholic Welfare Council; John W. Studebaker, commissioner of education, Federal Security Agency; Dr. Baldwin M. Woods, University of California; Owen D. Young, honorary member of the Board of Directors, General Electric Company. James C. O'Brien, executive officer of the roster, will act in a similar capacity for the work of this committee. The committee is being asked to formulate recommendations and report to the National Resources Planning Board as quickly as possible.

Civil Service examinations are announced as follows: For analytical and research chemists, with salaries of $2,600 to $5,600 a year—any specialized branch of chemistry is included; analytical chemists at $2,600 to $3,200 are needed for chemical testing of materials, for compliance with specifications, checking health hazards by chemical methods and other analytical chemistry work—and for pharmacologist and toxicologists, $2,600 to $4,600 a year. In both these examinations, responsible professional experience must be shown, except for the partial substitution of graduate study. The Naval Observatory in Washington, D. C., is in immediate need of junior astronomers. The register of eligibles established as a result of the 1940 examination for junior astronomer is exhausted. These positions carry salaries of $2,000 a year and for sub-professional positions from $1,620 to $1,800. The U. S. Public Health Service needs health education consultants at $3,800 a year; associates at $3,200, and assistants at $2,600.

THE Torrey Botanical Club, New York, will celebrate the seventy-fifth anniversary of its foundation, beginning on June 22, when an anniversary reception and banquet is planned. During the week there will be symposia, addresses and field trips. Visits will be conducted to institutions and to places of botanical interest in and near New York.

THE Agricultural Experiment Station of the School of Agriculture, Stillwater, Okla., celebrated its fiftieth anniversary during the golden jubilee celebration of the Oklahoma Agricultural and Mechanical College on December 13, 14 and 15. Dr. Henry G. Knight, chief of the Bureau of Agricultural Chemistry and Engineering, who was director of the Oklahoma Station from 1918 to 1921, was one of the principal speakers, representing the research activities of the land-grant colleges. He spoke on "Future Markets for Farm Products" and on "Chemists and Engineers in Agriculture." Among the graduates of the institution who were named during the jubilee as the initial members of a newly established "Hall of Fame" were: Dr. R. R. Shively, vice-president and chief technologist of B. F. Drakenfeld and Company, "for his research contributions in the chemistry of ceramics and glass," and Dr. Roy C. Newton, vice-president in charge of research for Swift and Company, "for his combination of scientific and executive skill in building the research department of that company."

AS a war-emergency measure, the Harvard Medical School, the Boston University School of Medicine, the Tufts College Medical School and the new Harvard School of Dental Medicine have issued a joint statement to the effect that, beginning on July 1, they will go on a twelve-month basis. The new program of continuous operation will do away with the present summer vacation period and will shorten the period of medical training to three calendar years instead of four. Graduates of the School of Dental Medicine will qualify in four and a half years, instead of five as originally planned. No change in the amount of required work is contemplated in any of the institutions involved, and there is no intention of lowering standards.

THE Yale University School of Medicine will be conducted the year round for the duration of the national emergency. The course will thus be shortened from four to three years, and each year will comprise four terms of eleven weeks. Tuition for the full course will remain unchanged at $2,000. Because of the reduction in time for elective work, the thesis requirement will be waived for classes graduating in 1943 and thereafter under the three-year plan, but the thesis will be continued as an elective. It was also announced that provision had been made to increase the enrolment of each entering class from fifty to sixty students. The summer term will begin on June 29.

THROUGH a bequest of the late William Campbell, for many years Howe professor of metallurgy at Columbia University, two fellowships have been established. They are awarded primarily for graduate study and research in the field of metallurgy. Practical experience in metallurgy or previous graduate study is desirable. The stipend of each fellowship is fixed at the time of award by recommendation of the committee and will normally be an amount sufficient to meet the necessary living expenses of the incumbent of the fellowship. Further information can be obtained from Professor Eric R. Jette, School of Mines, Columbia University.

ACCORDING to the *Journal* of the American Medical Association, Harvard University and the Massachusetts General Hospital, Boston, have reached an agreement whereby the main phases of the work in cancer treatment and research now being carried on by the Collis P. Huntington Memorial Hospital of Harvard Medical School will be transferred to the General Hospital. The step was taken because of the belief that the care and treatment of medical specialties can be more efficiently handled as part of a large institution of general scope than in smaller individual units. Under the new arrangement there will be transferred to the Massachusetts General Hospital the in-patient and out-patient services at the Huntington Memorial. The laboratory and research work now carried on by the Harvard Cancer Commission, established in 1899, will continue under the supervision of the commission. The research activities of Dr. Joseph C. Aub, associate professor of medicine at the Harvard Medical School, will be carried on at the General Hospital in connection with the tumor clinic which the hospital has been conducting for many years. The remainder of the varied research work of the cancer commission will be continued in conjunction with the medical school. The equipment of the General Hospital, including its 1,000,000 volt x-ray machine, will be available to all patients at both the Huntington and the General Hospital, and the Harvard supply of radium, heretofore used at the Huntington, will be available to the Massachusetts General Hospital.

THE first report of the Sub-committee on the Ecology of Marine Organisms, Committee on Geologic Research, has recently been issued by the National Research Council. It is a mimeographed bulletin of fifty-two pages, containing material presented last May at the annual meeting of the Division of Geology and Geography. Most of the data in the report were obtained by the sub-committee in a canvass of individuals and institutions interested in marine ecology as related to paleontology. The report attempts to present a picture of current and recently completed activities together with an annotated bibliography of a number of recently published papers. The Division of Geology and Geography wishes to give the report a fairly wide distribution in the belief that it will be found useful by paleontologists. Copies have been sent to individuals and to libraries, particularly those in the geological departments of colleges and universities. A limited number of copies are on hand and will be mailed to those desiring them. Requests should be addressed to the Division of Geology and Geography, National Research Council, 2101 Constitution Avenue, Washington, D. C., accompanied by fifteen cents to cover cost of postage and handling.

DISCUSSION

THE CURRENT LIST OF MEDICAL LITERATURE—AN EXPLANATION

LATELY, much has been written of the little planeographed weekly list of medical literature issued by the Friends of the Army Medical Library. One of the latest comments, and a very intelligent one at that from the view-point of its writer, was an article published in the September 26 issue of SCIENCE, in which Joe Hare, of the University of Denver, praised the list as being "*potentially by far the most important index*" of current literature in any scientific field (italics by me). He called the list an *index*, and criticized its "weird" classification. Since he also expressed his fear that the carelessness of classification committed by the weekly list may reflect badly upon "the excellent classification found in the Index-Catalogue," I think that it is time to throw light upon the historical background of this new bibliographical aid, upon its aims and its *accidental* relation to the Army Medical Library and its Index-Catalogue. Being one of the midwives assisting at the birth of the weekly list, and, to a certain extent, nursing it through its infancy, I may probably tell more about the difficulties of its birth, the weak constitution of the child, and so forth, than the casual observer.

The rather short history of the Current List is closely connected with the development of microfilm service of the Army Medical Library. This service can be traced back to 1937. In that year, Colonel Harold W. Jones, the librarian, saw the great possibilities of microfilming, and gave permission to the Bibliofilm Service, then operating at the Department of Agriculture, to film the library's books and journals if requested by the customers of that service. During the following two years, Bibliofilm Service copied many books and journal articles in the Army Medical Library, but it was felt that such an external agency would never be a proper substitute for what should be an extension service of the library. Filling out its many orders was always a great burden to the library staff which, since it did not have any supervisory power over the preparation of microfilms, could do little or nothing for the improvement of films delivered to patrons who always considered the library responsible for any defects found in the films received. For this and many other reasons it seemed to be desirable to establish a microfilm service of our own, operated in the spare time of our employees.

About a year ago, Dr. Seidell, who has been one of the early sponsors of the inauguration of microfilm services in public libraries, offered the librarian a microfilm equipment to be installed in the library building. The library being a government operated institution, a microfilm service could not become an official part of the library without a special authorization by Congress and without appropriation of public funds for its management and maintenance. In addition, an official microfilm service was not at all desirable because its operation would require a large personnel for bookkeeping, accounting, and so on.

A group of persons of high professional standing, who later took the name of Friends of the Army Medical Library, decided at this time that, instead of going through the endless maze of official sanction, the microfilm service should operate as a private organization of the Friends, with permission of the Surgeon General of the Army.

The Friends realized that a microfilm service without a sufficient steady patronage sooner or later would have to be discontinued. Of what avail is a microfilm service for a scientist who is not informed about the recent material available in the library? Should he wait until the printed and classified bibliographies call his attention to the recent developments? Or should the man from Texas or Oregon fly to Washington in order to glance through the subject cards prepared daily by the library staff for the Index-Catalogue from the large daily mail of scientific journals? Here seemed to be an opportunity for the Army Medical Library to become a bibliographical source for the medical research of the whole nation and even of the entire Western Hemisphere. Therefore, the Friends sought for means to extend the library's services and to build a bridge between the card file of the library and the study desk of the scientist.

Theoretically, a daily list of medical literature or a contact by the Teletype system would best answer the scientist's eagerness for quick information, but none of these is practical or economical. The next best solution seemed to be a weekly list of scientific papers. This idea had its chief support in the fact that there was almost no money needed for the preparation of the list. The proposed Current List did not need money in order to subscribe to thousands of medical journals, nor to maintain a large staff of indexers and foreign translators. Neither did it need any to pay an editorial staff. Almost everything was there, ready in the library, ready for a lease-lend. The Friends merely needed to borrow the daily achievements of the library staff, and to allow the references to medical papers to be copied by a typist.

Thus the weekly list took its origin as a private publication of the Friends. It was called a *list* with purpose, and it should not be taken for anything else but a private list, and a very primitive type of bibliographical aid at that.

The method of arrangement was selected in order to avoid even the slightest pretension to being called a classified index, and to prevent any confusion with the official publication of the library, the Index-Catalogue.

It should not be forgotten that in preparing the weekly list, the Friends are just readers of the library, borrowers of its material. The reference cards of the Index-Catalogue are *loaned* to them at the closing time of the library; they are copied at night, and returned next day to the regular subject file of the library. There is no connection whatever between the publication of the Current List and the Index-Catalogue, beyond the borrowing of the cards. The list is prepared outside the library, the arrangement of titles and the grouping of journals by pasting the typed sheets under the 44 arbitrarily selected groups being done at the private home of the typist. Everything is necessarily done hurriedly in order to have the weekly issue ready in time. There is no supervision of the copy prepared for planeographing. The Friends do not supervise. On the other hand, neither the librarian nor the editor of the Index-Catalogue nor the library itself could or should assume officially any editorial supervisory power over such a type of privately issued list; nor under these circumstances can they be held responsible for the "weird cataloguing" in the list.

In fact, it is doubtful if any one should be blamed when in an unclassified list of scientific papers the contents of a whole number of an entomological journal sometimes crawl into the Anthropology class, or if the Archiv für Rassenbiologie slips into the Microbiology group. It would not be possible to arrange half of the contents of a journal under one heading, and the other half under another heading if, by its title, the journal itself happens to belong to the group of Societies and Miscellaneous. The article on "Vitamin K in obstetrics," mentioned by Joe Hare as an example of slipshod classification, was published in the *Journal of the Medical Society of New Jersey,* together with several other articles on various other topics. While the articles themselves may belong to at least nine different groups, the journal itself is correctly put into the group of society publications.

I would prefer to say that there is no classification in the Current List. The arrangement of journals under 44 groups is certainly anything but classification. Such an arrangement has absolutely nothing to do with the highly detailed classification system of the Index-Catalogue. The grouping of journal names can not be more than a very rough approach at separating 1,000 titles into smaller units. The number of groups had to be limited to 44 because there was no place for a larger number on the front cover of the weekly list. The number of groups originally suggested was 71, but I doubt whether even 100 groups of journals could help much in bringing together under the proper subject the miscellaneous contents of such periodicals as the *Deutsche medizinische Wochenschrift,* the *Lyon médical* or the *Connecticut Medical Journal.*

A true subject classification of the articles themselves would cost much more than ten cents per issue. First, a classified and faultless bibliographical index would require a special staff for its preparation, with a well-paid editor who is both a linguist and a scholar, and with several typists who also know foreign languages. Moreover, the correct classification and the typing would have to wait until the end of the week, when all the references have been gathered for one issue. This would cause a delay of at least two weeks. Even then the classification should be left in a more or less rough preliminary stage because one thousand articles referring from all fields of science to the many aspects of medicine are far too few to permit their being arranged either in a sort of "catalogue raisonnée" or in an alphabet of very detailed subject headings. Also, it would be necessary often to repeat the same reference twice or three times in order to answer the needs of different specialists and to do justice to certain very complex publications. It was calculated that, even if the complex articles would not amount to more than 30 per cent. of all publications, such a weekly issue of the Current List would have to be increased to 60 or 70 pages with all the possible double, triple or multiple cross references. The cost of such a weekly issue would be about $240.00, and the yearly subscription not less than $20.00. Even then, an annual index would be still required, because to search fifty-two weekly numbers is a great waste of time.

Is it not better to pay only $5.00 and to leave the Current List as it is? Is it not better to consider it just a rough register, and not to try to boost it into the higher class of the systematic subject catalogue or of the bibliographical index? As a simple register, it is very useful as an enumeration of the contents of the latest issues of journals received by the Army Medical Library. Its only scope is to fill in the time between the issues of the printed and better classified bibliographical keys to medicine. Yet, even as a simple register, it can be used with much advantage. For instance, I am using it for collecting special bibliographies on various subjects I am personally interested in. As soon as the weekly issue comes to my hand, I read it through from Anatomy to group Zoology and mark all the articles I should like to see immediately or in the future. It is then the task of my assistants to copy the marked titles for my personal card file with the exact reference either to the column number of the Current List or to the original itself. The same method could be adopted by any one having the Current List. Indeed, every one should prepare his own bibliographical subject file from this rough weekly register. Bibliographical search being an integral part of research itself, the Current List should never aspire to become more than a rough register, a source left unclassified and undisturbed to be searched intimately and personally by the scientist.

A few more words on the supplementary lists of Recent Book Acquisitions. Such lists have been issued for the last four years by the library in a mimeographed circular, and mailed to other libraries and institutions for the primary purpose of facilitating interlibrary loans, thereby reducing the inquiries as to the holdings of this library to a minimum. The lists served this purpose well, and they are still chiefly for the use of libraries. Individual scholars perhaps would like to have annotated lists of medical books to show them what is trash and what is treasure. Such lists can never be expected from a public institution because annotations with recommendation or condemnation would reduce the library to the rank of the advertising agencies. The list of books is still prepared by the library, which now receives 150 copies to be mailed out gratis to other libraries. The books are arranged under 71 different subjects, and this number was found sufficient to deal with all types of books which the Army Medical Library has received so far. Since each independent publication is individually catalogued, the list includes more than 90 per cent. of the acquisitions. What is left out is of little importance, belonging rather into the class of reprints (many German theses, typewritten theses, etc.).

With this explanation, I believe that the Current List can take its correct place among the bibliographical tools of medicine, and I hope that nobody will expect more from it than what it can offer to the scholar; that is, an almost up-to-date privately published simple register of a conglomerate of journal articles received by a single large medical library and arranged in some rough groups of journals, with no attempt at a systematic classification or proper indexing of subjects.

CLAUDIUS F. MAYER,
Editor of the Index-Catalogue
ARMY MEDICAL LIBRARY

THE DUPLE: A LOGARITHMIC UNIT

To the current number of *The Mathematical Gazette*[1] I have contributed a little homily on numeration and mensuration entitled "Octonaria" which adumbrates the advantages of reckoning by eights rather than in the scale of ten. These are sufficiently manifest to need no elaboration, but there is a cognate matter which also merits consideration—the question of logarithmic units, which was raised ten years ago by Dr. A. H. Davis.[2]

It will be recalled that Dr. Davis proposed that a 10-fold change in any quantity should be called a change of one *brig*, a unit which he subdivided to obtain a more convenient *decibrig*. That these units have not become current may perhaps be ascribed not only to the fact that the brig itself is rather large but also to the somewhat involved conception inherent in the decibrig.

In this matter there may be some advantage in being practical and making more use of the simple scale of two: an appropriate name for a binary change would help and the suggestion is now made that the necessary connotation be given to the word *duple* and that the portmanteau-word *tootthа*[3] might be legitimatized. Eight-fold is 3-duple and a 16-fold change or difference a change of 4 duples. In terms of acoustic intensity, one duple equals 3.01 "decibels": an increase of 15 "phons" is a 5-duple change in loudness.

The readier appreciation of values expressed in the scale of two, which familiarity would engender, might prove helpful in more worldly matters, in the purchase of a horse, for example. In terms of the usual farthing for the first shoe-nail,[4] two farthings for the second, and so on to the twenty-fourth nail, the price in farthings amounts to tootthа 24 less one, that is £17,476 5s. 3¾d., and a bargain for King Richard.[5]

The annexed table of tootthа will be recognized by

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[1] P. Simple, *Mathematical Gazette*, October, 1941.

[2] A. H. Davis, *Phys. Soc.*, 1931, *Report of a Discussion on Audition*, p. 136.

[3] Tootthа = *two to the* power of.

[4] Oliver Lodge, "Easy Mathematics," London, 1905, p. 155.

[5] Will Shakespeare, "Richard III," London, 1597.

Tootha

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	1	1.07_2	1.15	1.23	1.32	1.41	1.52	1.62	1.74	1.87
1	2	2.14	2.30	2.46	2.04	2.83	3.03	3.25	3.48	3.73
2	4	4.29	4.60	4.92	5.28	5.66	6.06	6.50	6.96	7.46
3	8	8.57	9.19	9.85	10.6	11.3	12.1	13.0	13.9	14.9
4	16	17.1	18.4	19.7	21.1	22.6	24.3	26.0	27.9	29.9
5	32	34.3	36.8	39.4	42.2	45.3	48.5	52.0	55.7	59.7
6	64	68.6	73.5	78.8	84.4	90.5	97.0	104	111	119
7	128	137	147	158	169	181	194	208	223	239
8	256	274	294	315	338	362	388	416	446	478
9	512	549	588	630	676	724	776	832	891	955

financial experts as showing compound interest; at £7 3s. 6½d. per cent., money doubles itself every ten years, and in a century increases a thousand-fold.

Tootha makes light of astronomical figures: even the number of electrons in the universe amounts only to some tootha 262.8, a figure now shown as $2^{262.8}$ but which might with some advantage be written 2\262.8 or, even more simply, \262.8. Curiously enough, the universe itself seems more within our grasp when we reckon its diameter, not by the thousand million light-years, but as 2\74.2 miles.

Peter Simple

England,
October, 1941

ORIGIN OF THE JAPANESE WALTZING MOUSE

In 1912 Fortuyn[1] pointed out that the Japanese waltzing mouse was smaller, and had a shorter tail with a lower number of tail-rings, than European *Mus musculus*. Being quite unfamiliar with the species of Asiatic wild mice, he asked for the advice of the late Oldfield Thomas, of the British Museum, and was told that the only wild mouse of this type occurring in eastern Asia was *Mus musculus wagneri* Eversmann, at that time called *Mus wagneri*, and regarded as a species different from *M. musculus*. As Fortuyn was convinced that the Japanese waltzer was derived from a type distinct from the European house-mouse, he accepted this information as the basis of his contention that the derivation of the waltzer from *wagneri* was a proven fact.

More recently W. H. Gates[2] has supported Fortuyn's view, and has adduced morphological and physiological, as well as historical facts in its favor. Keeler,[3] primarily on historical grounds, has maintained a south Chinese origin of the waltzer.

Through the kindness of Dr. G. M. Allen, of Cambridge, Mass., I have recently had an opportunity to examine specimens received from Dr. Fortuyn, including 24 waltzing mice (8 white, 8 black, 8 Dutch piebald), and 9 wild *wagneri* from Peking, China. They bear out the resemblance between the two types, as described by Fortuyn and Gates. Therefore, it can be taken as proved that the Japanese waltzer has nothing to do with the European house-mouse.

However, the evidence that these mice were first bred in China, and were taken to Japan later on, can not be accepted as conclusive for the following reasons.

(1) *M. m. wagneri* Eversmann is not the only wild race of short-tailed mice of this group, found in eastern Asia. A second wild subspecies, *M. m. manchu* Thomas (1909),[4] is found in Manchuria and Japan. *Wagneri* and *manchu* are very closely related, but in populations of *manchu* a buff, and a dark grey color phase are found, whereas in *wagneri* only the buff phase is known.

(2) The Japanese house-mouse, *M. m. molossinus* Temminck, is derived from the local wild stock of *M. m. manchu*, from which it differs by its small size, and in having the belly buffy, instead of white. It has the same two color phases as the wild stock, the buffy and the dark grey, and almost as short a tail. When Thomas gave his information to Fortuyn, he was not aware of the occurrence of *M. m. manchu* in Japan, nor of the fact that *molossinus* was the common Japanese house-mouse, and that in Japan the European house-mouse does not exist.

(3) The house-mice of southeastern China, as far north as the Yangtze River, belong to the Indian type. They have very long tails, much longer than the head and body. They closely approach the European style, but differ widely from the short-tailed Japanese house-mouse.

(4) No true house-mice occur in northern China. The house-mice there are facultative commensals, and do not differ considerably from the local wild *wagneri*.

(5) The Japanese waltzer agrees in size and tail-length with the Japanese commensal *M. m. molossinus*. There is no need to suppose that it has been taken to Japan from elsewhere. It can not have been bred in northern China, where no true commensal mice are found, nor can it be derived from the house-mice of southern China, from which it is widely different.

Ernst Schwarz

U. S. National Museum

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[1] A. B. D. Fortuyn, *Zool. Anz.*, 39: 88, 1912.

[2] W. Gates, Carnegie Inst. Washington, Publ. 337: 91, 1926.

[3] C. E. Keeler, "The Laboratory Mouse. Its Origin, Heredity and Culture." Cambridge, Mass., 1931.

[4] O. Thomas, *Ann. Mag. Nat. Hist.*, (8) 4: 22, 1909.

SCIENTIFIC LITERATURE

GROWTH OF PRIMATE LITERATURE SINCE 1800

IT is only within the past decade or two that the study of the primates as a distinct zoological group has come into sufficient stature to warrant separate designation—"primate biology" or if you will, "primatology." That such a cleavage is not merely a terminological one is witnessed by the fact that individual workers and even whole laboratories are almost exclusively devoted to the study of this order. Nor does the interest in the primates lie only in their rôle as man's unhappy vicar in laboratory experimentation. Rather is the interest broader and more truly biological.

The drawing together of the literature of the primates,[1] in three of its phases, anatomy, physiology and psychobiology, affords an opportunity to survey the present status and the development of primate biology by analyzing the collective literature with respect to time, subject, place of publication, etc. Perhaps the most striking thing of all is the restricted character of the literature. Extensive searching yielded some 4,630 articles or books relating to the anatomy, physiology and behavior of the primates published prior to the beginning of 1939. In this number are counted many works in which representative primates are treated along with others of the mammalian or vertebrate series, and in certain sections many "popular," anecdotal and descriptive papers are included. This whole literature represents but a fraction of attention devoted to almost any other group of animals. Man, so often self-accused of anthropocentricity, does not in his zoological interests show any intense preoccupation with his next of kin.

Another fact which emerges without analysis is the not unexpected preponderance of morphological over functional studies. Classified as anatomical (*i.e.*, systematic anatomy, embryology, histology and studies employing the techniques of physical anthropology) are 2,734 titles or 59 per cent. of the whole (4,630); as physiological and pharmacological, 896 or 19 per cent.; and as psychobiological 669 or 14 per cent. The latter should perhaps be broken down as is done in the bibliography into experimental and observational psychobiology, the former numbering 316 papers or 6 per cent. The remaining papers were published before 1800 or fall under the category of miscellaneous bibliographies, which include such topics as "phylogeny of the primates," "primate culture and methodology," "the primates in mythology," etc. One reason for the preponderance of structural studies lies certainly in the relative unavailability of living primate forms in adequate quantities for functional studies. Another without doubt is historically grounded, and is brought out by graphing the number of papers appearing in each subject per year. It is quite clear from this graph that the three subjects got underway in the order of anatomy, physiology and psychobiology. Morphological studies show a steady increase in number except for the years marred by the first World War, with, perhaps, a tendency for slower growth in the past fifteen years. Physiological studies made a rather definite beginning in the last decades of the nineteenth century, due no doubt to the English and German investigations of the nervous system. A steady though not accelerating interest was exhibited in primate physiology until well after the war. Beginning about 1930 has come a remarkable increase in the number of physiological papers, until functional and morphological studies become roughly equal. Experimental psychobiology though later in starting (*c.* 1910) parallels in growth its fellow functional science.

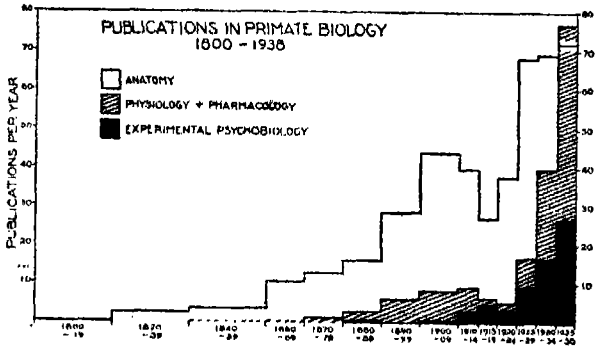

FIG. 1

It is interesting to speculate on the factors determining the growth of these subjects. Does the plateauing of anatomical studies in the past decade and a half denote simply a maturing of a subject? Or does it reflect a change in the attitude of anatomists from a comparative to a functional approach, causing him to be recruited into the ranks of the physiologists? The many important contributions to the physiology of the nervous and endocrine systems coming from anatomical laboratories in recent years are indicative of some such process. Though the literature has not been analyzed from this point of view, the burst of activity in physiological and psychobiological investigation coming in the past decade must in some degree reflect the stimulus afforded by the creation of laboratories for primate research by the foundations.

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[1] T. C. Ruch, "Bibliographia primatologica: A Classified Bibliography of Primates Other Than Man. Part I. Anatomy, embryology and quantitative morphology; physiology, pharmacology and psychobiology; primate phylogeny and miscellanea." xxvii + 241 pp. Springfield, Ill.: Charles C Thomas, 1941.

The break in the orderly march of these subjects occasioned by the war and extending well into the post-war years, is cause for speculation on the course these graphs will take in the next five-year period.

T. C. RUCH
J. F. FULTON

LABORATORY OF PHYSIOLOGY,
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SOCIETIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE forty-ninth meeting of the Tennessee Academy of Science was held in Nashville on November 28–29, at the George Peabody College for Teachers. President F. L. Wren presided. Friday and Saturday mornings were devoted to general sessions, with Friday afternoon reserved for sectional meetings. Fifty papers were presented.

The following chairmen presided at the section meetings on Friday afternoon: *Botany:* D. M. Brown, State Teachers College, Johnson City; *Geology and Geography:* R. A. Laurence (for B. C. Moneymaker), Tennessee Valley Authority, Chattanooga; *Mathematics:* W. L. Miser, Vanderbilt University, Nashville; *Chemistry:* L. J. Bircher, Vanderbilt University, Nashville.

The annual dinner was held on Friday night at the James Robertson Hotel. Vice-President D. M. Brown served as toastmaster. The address of Retiring President F. L. Wren was on the timely topic, "Our Public Trust," in which the speaker emphasized the new role and responsibility of science in the world of to-day. A beautifully colored motion picture, "The Sportsman's Dollar," was shown by the courtesy of the Educational Service of the State Department of Conservation.

At the meeting of the executive committee on Friday and at the general business session on Saturday, the following business was transacted: (1) A committee appointed to proceed in the organization of a Junior Academy of Science. (2) A committee appointed to canvass the state to determine the number and type of science groups with the possibility of offering student membership in the academy at a reduced rate. (3) Jesse M. Shaver was elected representative of the academy on the Council of the American Association for the Advancement of Science. (4) Recommendations will be made to the incoming executive committee that in place of the regular spring meeting the academy convene with the newly organized Southern Association for the Advancement of Science.

New officers for 1941–42 were elected as follows: *President:* D. M. Brown, State Teachers College, Johnson City; *Vice-President:* C. S. Shoup, Vanderbilt University, Nashville; *Secretary-Treasurer:* Kendall E. Born, State Division of Geology, Nashville. *Section Chairmen: Botany:* Frances Ranney Bottom, George Peabody College for Teachers, Nashville; *Geology and Geography:* Robert A. Laurence, Tennessee Valley Authority, Jefferson City; *Mathematics:* J. A. Cooley, University of Tennessee, Knoxville; *Chemistry:* C. A. Buehler, University of Tennessee, Knoxville.

KENDALL E. BORN,
Secretary-Treasurer

SPECIAL ARTICLES

A NEW PROTEASE FROM BROMELLA PINGUIN L.[1]

THE juice obtained from the fruit of the *Bromelia pinguin* L., commonly called "maya" in Puerto Rico, has a pleasantly acid taste, but produces a burning sensation when applied to the hand or lips, peeling the skin after a few hours.

Suspecting the presence of a proteolytic enzyme in this juice, it was tested by the milk-clotting method of Balls and Hoover,[2] as well as by the formol titration, using gelatin as a substrate. Similar tests were performed on heat-inactivated juice which served for control tests. The result of these trials is reported in Table I, which shows the presence of a protease in the juice.

To obtain the crude enzyme, 100 cc of fresh maya juice were filtered with celite. To the filtered juice,

TABLE I

Juice	pH	Milk clotting units per cc of juice*	Formol titration. cc 0.01N NaOH per cc of juice
Fresh	4.0	50	3.80
Boiled	4.0	No clotting	1.10

* A milk-clotting unit is defined here as the amount of enzyme preparation required to clot 5 cc of standard milk solution from dried milk in one minute at 40° C.

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[1] Published with the approval of the director of the School of Tropical Medicine and of the director of the Agricultural Experiment Station of the University of Puerto Rico. A cooperative project.

[2] A. K. Balls and S. R. Hoover, *Jour. Biol. Chem.*, 121: 737, 1937.

pH 4.9, 300 cc of acetone were added and the precipitate obtained, separated by centrifugation. The precipitate was dissolved in 100 cc of 0.02 M NaCN and then reprecipitated by the addition of another 300 cc of acetone. This last precipitate was washed with acetone and ether and then placed in a vacuum desiccator over $CaCl_2$. The dried precipitate was pulverized in a porcelain mortar until a fine, whitish powder was obtained. The yield of crude enzyme was 5 gm.

The activity of this preparation, when in solution at a pH 5.9, is of 390 milk-clotting units per gm. This enzyme is a typical papainase, as it is reversibly inactivated by H_2O_2 and iodine, and activated by NaCN and cysteine. Like other papainases, this enzyme digests live tissue. *Macracanthorhynchus hirudinaceus* (from hog intestine) were digested by a 1 per cent. solution of our enzyme preparation in less than 12 hours, when incubated at 40° C at pH 5.5. Controls in the same solution, previously boiled, were not digested.

The amount of crude enzyme that can be recovered from maya juice is a little over 17 times the amount of bromelin obtained from the average pineapple juice. Both enzyme preparations have about the same milk-clotting activity, therefore the maya may prove, in the future, to be an important source of a papain-like enzyme.

Having found in the available literature no account of this enzyme, we submit this brief report, which will be followed in due course by a more complete description, and suggest the name "pinguinain" for this new enzyme, as the generic name of the plant source has already been used in naming bromelin, the enzyme obtained from the pineapple.

CONRADO F. ASENJO
M. DEL C. CAPELLA DE FERNANDEZ
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PARTICULATE GLYCOGEN*

BY fractional centrifugation of finely dispersed liver suspensions a submicroscopic particle containing glycogen was obtained. This particle has an approximate sedimentation constant of $4,000 \times 10^{-13}$. This means a particle size much larger than the tobacco mosaic virus, which has a molecular weight of 15–20 million and a sedimentation constant of $191–239 \times 10^{-13}$.[1] The particle is stable at 37° C. but can be dispersed by heating at 100° C. for several hours. It may also be dispersed by trichloracetic acid or potassium hydroxide. The dispersed glycogen can not be separated at 12,000 r.p.m.; this is the speed used to separate the original particle. According to Oakley and Young,[2] glycogen separated by the usual methods has a molecular weight of only two million. Clearly, then, particulate glycogen is an aggregate of smaller glycogen units.

The particle contains a high percentage of water; however, practically all the dried residue is glycogen. The dried particle also contains about 1 per cent. protein. This protein may play an important role in the maintenance of the particle, inasmuch as all the agents which disperse the particulate glycogen markedly alter the protein. None of these is thought to alter the properties of glycogen.

It is clear that, if this protein, or some other agent, combines with the dispersed glycogen as the latter is synthesized in the liver cell the glycogen will be removed from solution. By the law of Mass Action the enzymatic reaction

$$\text{Glucose-1-phosphate} \rightleftharpoons \text{Glycogen} + \text{Phosphate}$$

would be shifted in favor of glycogen synthesis, therefore facilitating glycogen storage in the liver. The concentration of glucose in the liver cell would be diminished. This would favor the removal of glucose from the blood stream and a consequent lowering of blood sugar.

The action of this coacervating agent, which may be protein, seems to parallel the action of insulin, because insulin is known to lower blood sugar and facilitate glycogen storage in the liver. The relationship, if any, between the protein contained in particulate glycogen and insulin is being investigated.

I should like to express my deep appreciation to Professor R. R. Bensley for his suggestions, criticisms and constant encouragement.

ARNOLD LAZAROW
UNIVERSITY OF CHICAGO

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* This work was aided by a grant from the Dr. Wallace C. and Clara A. Abbott Fund of the University of Chicago.

[1] Eriksson-Quensel and Svedberg, *Jour. Am. Chem. Soc.*, 58: 1863, 1936.

[2] Oakley and Young, *Biochem. Jour.*, 30: 868, 1936.

AN UNIDENTIFIED VIRUS WHICH PRODUCES PNEUMONIA AND SYSTEMIC INFECTION IN MICE[1]

IN the course of attempts to isolate viruses by direct inoculation of albino Swiss mice with throat washings from clinical cases of influenza, non-influenzal pneumonias were frequently encountered in the passage mice. The pneumonias observed were of two types. One type was grossly indistinguishable from that produced by influenza virus, and the etiological agent of this type was found to be a filtrable virus

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[1] These investigations were financed largely by a grant from the International Health Division of the Rockefeller Foundation.

which was subsequently identified, on the basis of serological reactions, with that described by Horsfall and Hahn.[2] Dochez, Mills and Mulliken[3] and Gordon, Freeman and Clampit[4] have described similar pneumonia-producing viruses isolated from apparently normal mice. The second type of pneumonia encountered was likewise found to be due to a filtrable virus, but the microscopic demonstration of elementary bodies, the characteristic appearance of the early lesions,[5] the greater virulence and the serological reactions definitely distinguished this virus from the former.

Three strains of this virus were isolated from mice during the course of serial lung passages initiated with throat washings from three different cases of clinical influenza. Two strains were subsequently isolated from apparently normal mice in the course of serial lung passages initiated with the lungs of uninoculated mice. These five strains of virus were apparently identical.

The etiological agent was found to pass through a Berkefeld N filter. When stained with Giemsa, Castaneda and Macchiavello stains, virus particles of variable morphology, similar to those described for psittacosis and lymphogranuloma venereum, were demonstrable.

The virus was readily cultivated by the method of Cox[6] in the yolk sac membrane of the developing chick embryo, the morphological characteristics of the cultivated virus being in every way identical with those seen in lung preparations from infected mice.

The earliest pulmonary lesions observed in mice consisted of scattered pinpoint raised gray focal lesions. With progression of the infection these lesions coalesce to produce complete pulmonary consolidation grayish red in color. Intranasal inoculation of 0.05 cc of a 10^{-1} suspension of infected mouse lung kills mice within 24 hours.

Upon intracerebral inoculation of mice, the virus was recovered from both brain and lungs but could not be passed serially from brain to brain. Upon intranasal inoculation, virus was recovered from the lungs and spleen but not from the brain. These observations indicate both pneumotropic and viscerotropic properties.

A more complete presentation of the study of this virus will appear in a subsequent publication.[7]

CLARA NIGG

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MINNEAPOLIS

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[2] Frank L. Horsfall, Jr., and Richard G. Hahn, *Jour. Exp. Med.*, 71: 391, 1940.

[3] A. R. Dochez, K. C. Mills and B. Mulliken, *Proc. Soc. Exp. Biol. and Med.*, 36: 683, 1937.

[4] F. B. Gordon, Gustave Freeman and J. Marion Clampit, *Proc. Soc. Exp. Biol. and Med.*, 39: 451, 1938.

[5] A personal communication from Dr. Monroe D. Eaton and Miss M. Dorthy Beck has called my attention to the similarity between the elementary bodies and pulmonary lesions characteristic of this virus, the pneumonitis virus described by Eaton, Beck and Pearson (Monroe D. Eaton, M. Dorthy Beck and Harold E. Pearson, *Jour. Exp. Med.*, 73: 641, 1941) and the meningo-pneumonitis virus of Francis and Magill (Thomas Francis, Jr., and T. P. Magill, *Jour. Exp. Med.*, 68: 147, 1938).

[6] Herald R. Cox, *Public Health Rep.*, 53: 2241, 1938.

[7] Clara Nigg and Monroe D. Eaton. To be published.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

COMPUTING SCALES FOR CALCULATING PERCENTAGE DEVIATION FROM AVERAGE WEIGHT[1]

THE accompanying scales were set up to calculate the percentage by which a man of specified age, height and weight differs in weight from the average of accepted white male life insurance applicants of the same age and height.[2] To use these scales, first set a pair of dividers on the appropriate rulings on the left-hand scale. These rulings have been so calibrated that the span between the divider points represents the logarithm of the average weight of men whose heights and weights are specified. The dividers are then lifted; one point is placed, as illustrated, at the proper place on the weight scale, and opposite the lower point, one can read off the percentage deviation. In this operation, one subtracts the logarithm of the expected weight from the logarithm of the observed weight, obtaining the logarithm of the ratio of observed to expected weight. The lower part of the right-hand line is labeled so that the ratios can be read off directly.

The net effect is to replace three variables, height, age and weight by one new variable, percentage weight deviation. In certain statistical problems[3] this represents a useful simplification of the data. The computing scales of Fig. 1, or a slide rule described elsewhere,[4] may be used in problems in which height, weight and age are under study.

In other problems involving multiple correlation or joint correlation, it may be advantageous to make allowance for an entirely different set of variables. A brief discussion of the principles on which Fig. 1 is based may be helpful to an investigator who wishes to make a similar computing device to fit his own data. No novelty can be claimed for arranging logarithmic scales so that computations can be carried out with dividers. In 1620, Edmund Gunter (1581–1626) arranged logarithmic scales so that the operations of multiplication and division could be carried out with compasses. Such scales, under the name of gunters, were used for many years by mariners. In more recent times, however, the method seems to have been neglected.

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[1] From the Division of Industrial Hygiene, National Institute of Health, U. S. Public Health Service, Washington, D. C.

[2] Assoc. Life Insurance Med. Dir. and the Actuarial Soc. Amer. Medico-Actuarial Mortality Investigation. Vol. I. 1912.

[3] P. A. Neal, R. H. Flinn, T. I. Edwards, *et al.*, *Public Health Bulletin* No. 263, 1941.

[4] T. I. Edwards, A slide rule and two nomograms by which the percentage deviation of a man from the average weight of men of his height and age may be calculated. *Amer. J. Hyg.* In press.

The height-weight-age data under discussion are an instance of multiple correlation. That is to say, if the relation between weight and height is determined for men aged 30–34, the same relation may be made to apply to men of any other age group by translocating the weight-height equation along the age axis. Ordinarily, translocation would be accomplished by adding certain amounts to the equation describing the weight-height relation for men aged 30–34 (or subtracting them, as the case might be). In this instance, the computing scales were meant to yield a ratio, and this made it desirable to work in logarithms throughout. The easiest way to make the weight-height relation describe different age groups was to multiply it by an appropriate factor.

The equations used to fit these data are shown in Fig. 1 and are plotted at the foot of that figure. They were obtained by the method of least squares. There were 128 average-weight values in the set of data on which these equations were based, representing 16 height classes from 60 inches ($x = 1$) to 75 inches ($x = 16$) and 8 age classes from 15–19 years ($y = 1$) to 50 years and over ($y = 8$). All but about half a dozen of these 128 average weights can be predicted to within a pound by means of these equations. The aberrant values lie in the extreme corners of the table.

In this example, the computing scales have been used to reduce three variables to the form of a ratio. This, of course, is not the only operation which can be expedited. Almost any operation involving the addition or subtraction or the multiplication or division of three variables that can be carried out on special slide rules or by other nomographic methods can be set up as computing scales, or gunters; in many instances with less labor. Before making many computations it would be advisable to protect the scales by a strip of scotch tape or some other transparent material. Dividers fitted with a fine adjustment screw are convenient.

THOMAS I. EDWARDS

NATIONAL INSTITUTE OF HEALTH

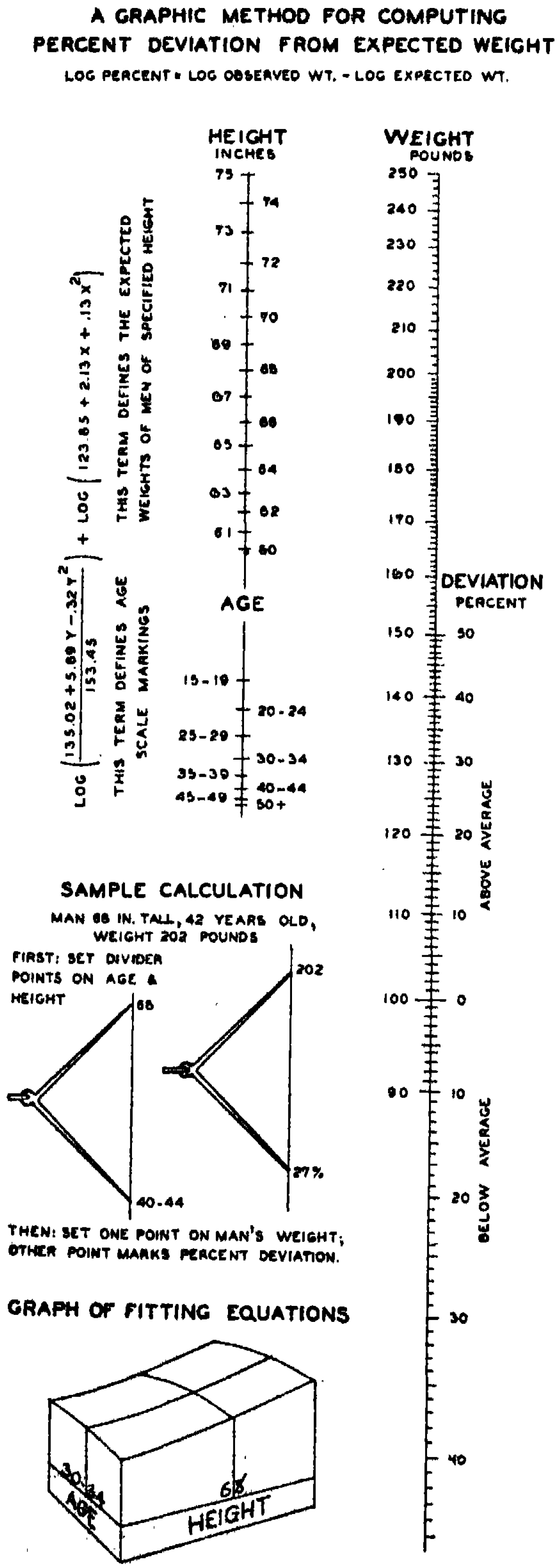
A GRAPHIC METHOD FOR COMPUTING PERCENT DEVIATION FROM EXPECTED WEIGHT
LOG PERCENT = LOG OBSERVED WT. - LOG EXPECTED WT.
HEIGHT INCHES
75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60
WEIGHT POUNDS
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90
DEVIATION PERCENT
50 40 30 20 10 0 10 20 30 40
ABOVE AVERAGE
BELOW AVERAGE
AGE
15-19 20-24 25-29 30-34 35-39 40-44 45-49 50+
LOG (135.02 + 5.89Y - .32Y²)/153.45 + LOG (123.65 + 2.13X + .13X²)
THIS TERM DEFINES AGE SCALE MARKINGS
THIS TERM DEFINES THE EXPECTED WEIGHTS OF MEN OF SPECIFIED HEIGHT
SAMPLE CALCULATION
MAN 68 IN. TALL, 42 YEARS OLD, WEIGHT 202 POUNDS
FIRST: SET DIVIDER POINTS ON AGE & HEIGHT
68
40-44
202
27%
THEN: SET ONE POINT ON MAN'S WEIGHT; OTHER POINT MARKS PERCENT DEVIATION.
GRAPH OF FITTING EQUATIONS
30-34 AGE
68 HEIGHT

FIG. 1

RAPID TRANSMISSION TECHNIQUES FOR STONE-FRUIT VIRUSES

The nature of the virus diseases of woody plants, including the stone fruits, is such that without the insect vector transmission can ordinarily be effected experimentally only by grafting. The chief obstructions to progress have been: (1) the apparently long incubation periods that obtain when ordinary transmission techniques are employed, (2) the lack of adequate details on how these viruses move in their respective hosts, (3) the almost complete lack of knowledge on the identity of the insect vectors, and (4) the lack of adequate attention to the possibility of developing new transmission and indexing techniques.

In studies on yellow-red virosis in peach[1] it was found that when a simple pruning technique was employed the incubation period was reduced from approximately a year to one month. The present modified technique involves: (1) the insertion of diseased buds about midway on the stems of rapidly growing peach seedlings[2] when between 12 and 24 inches tall and (2) cutting off the stem one node above the diseased bud from 0 to 7 days afterwards to stimulate a new spurt of growth.

This rapid transmission technique has since been tested for shortening the transmission periods of a number of other stone-fruit virus diseases which go to the peach, with equally successful results. Distinctive symptoms of such peach virus diseases as rosette, rosette-mosaic and mosaic have been induced on peach seedlings within a month from budding. A new yellows disease of the sour cherry has also been found to index readily on peach seedlings by producing the distinctive symptom of rosette within three weeks from budding. Similar rapid transmissions have been obtained with still other stone-fruit virus diseases.

Other less efficient ways of shortening incubation periods were by defoliation, girdling and fertilization. A promising variation, especially useful with older plants, involved placing the diseased bud on one side of the stem between two rapidly growing young shoots, the remaining shoots having been previously removed.

Dormant stone fruits including cherries, plums and peaches may respond quickly to another technique involving the grafting of diseased scions onto heavily pruned healthy plants just as growth starts. This modification in technique has been successfully employed in shortening incubation periods of several viruses in cherries and plums. Besides whip, approach, wedge and cleft grafts, chip buds consisting of bark and sapwood have been successfully employed at times when the bark will not slip. The whip grafting technique resulted in the transmission of a disease with the production of ring-spot symptoms on sour cherry (*Prunus cerasus* L.) in the extremely short period of 14 days from grafting.

The principle of the rapid transmission technique is the stimulation in a growing plant by pruning of a new spurt of growth which attracts the virus with the prompt appearance of symptoms. The response seems to best be explained by the idea that a virus moves bodily through a plant in the food translocation stream. Contact periods for effecting passage of viruses from diseased buds into the stem require only the few days necessary for the formation of a callus bridge between scion and stock. Ordinarily they pass into the stem and move downward to the lower stem and roots in the food stream and only return to the upper part of the plant during a period of rapid growth such as occurs after passage through another dormant period. Pruning stimulates the lateral dormant buds to activity and changes temporarily the course of the translocation stream from downward to upward until the new growth can support itself. The immediate inflow of plant foods carrying the virus gives the minimal incubation period. The new spurt of growth from the lateral buds which has been induced by pruning can be likened to the stimulation at will of next season's growth.

The principle of the pruning technique would seem to be almost universally applicable in the study of the virus diseases of woody plants.

E. M. HILDEBRAND

CORNELL UNIVERSITY

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[1] E. M. Hildebrand, *Contrib. Boyce Thompson Inst.*, 11: 485–496, 1941.

[2] Peach seedlings were found ideal for greenhouse studies. Batches of peach pits (southern, wild), after storage in moist peat at 5° C. (40° F.) for 10 weeks to break dormancy, were germinated in sand, transplanted to soil in 4 or 5 inch pots and ready to use at about 18 weeks from starting the dormant treatment. New batches of pits can be started at will any season of the year.

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THE GOLDEN AGE OF BOTANY[1]

By Dr. **EDGAR N. TRANSEAU**

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Those of us who were so fortunate as to enter the field of botany about the beginning of the century have witnessed the period of its greatest growth and differentiation. In no other country and at no other time have there been so many undergraduate students of botany, so many graduate students and so many botanists employed in educational and research institutions. We vividly recall that this 40-year period began just after the Spanish-American war when America took over the Philippine Islands. We have likewise had a part in all the educational phenomena before, during and after the first World War. The period closes as World War II is thrust upon us.

This time the war is not "to make the world safe for democracy," but to keep democracy from being crushed against the wall at its back. After the first world war came the collapse of European credits and subsequently a variety of social revolutions that have ended in ruthless dictatorships. The state-supported Continental universities were first impoverished, then regulated and finally regimented or liquidated. Because of declining financial aid, teaching and research in botany have been possible only to men of independent means, and in many of the Continental universities both these pursuits seem to have almost disappeared.

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[1] Address of the retiring president of the Botanical Society of America, delivered at Dallas, Texas, on December 29, 1941.

In post-war America, war inflation and war profiteering brought immediate hardships to college teachers during the early twenties. The late twenties brought a period of illusory expansion and easy money. Wild mergers and speculation failed to produce the then promised "new era." Rather it culminated in the bank holiday and the long depression of the thirties.

During this interval shrinkage of endowments and reduction of direct contributions threatened the very existence of many colleges and curtailed the programs of most institutions. In certain colleges only the devotion of the instructors and their willingness to continue on a subsistence basis prevented the closing of college doors. Even to-day these colleges have not fully recovered.

To relieve the widespread unemployment and the sorry plight of agriculture our national government then instituted a far-reaching program of social and economic experiments with the definite objective of increasing the purchasing power of the lower income groups. These included: Old age pensions; unemployment insurance; flood control measures; CCC camps; construction of rural subsistence communities; pegging the prices of farm products; farm loans; resettlement of farmers; forest and soil conservation; community planning, and game management. These projects have affected every rural and urban community, and the supervision of them has provided an ever-increasing number of jobs for engineers, agricultural and economic experts, foresters, zoologists and botanists. These projects have been financed in part through large internal loans.

Long before we have had an opportunity to evaluate the results and consequences of these experiments we have been plunged into World War II and we have determined to free the world of Hitlerism at any cost. In the last conflict we spent the equivalent of the present valuation of all taxable property in the United States west of the Mississippi River. Federal expenditures for the year just closing are not less than this sum, and the estimates for 1942 are more than twice this amount. The necessity for these military expenditures can not be questioned, but we should clearly realize the effects they will have on college and university resources. With this background in mind let us also try to picture what has happened in our own professional sphere and what may happen in the near future.

At the turn of the century botanical instruction in America was the natural outgrowth of the experiences of American students who had studied in various European laboratories, especially in Germany. The points of view and the techniques of instruction and research were importations direct, or indirect, hallowed by an aura of Old World traditions. Some of these foreign-trained professors, their associates and many of their students soon inaugurated new lines of research and, utilizing every new discovery in chemistry, physics and mathematics, have made American institutions outstanding in their contributions to both the pure and the applied phases of botany.

Certain of the foreign trained men of the early 1900's acquired a feeling that they must avoid problems that have immediate practical use, or are of direct social importance. This attitude was expressed by one of these men, allegedly quoting Pfeffer, "that he would leave the practical problems for the lesser minds." To him the study of a plant inside a Wardian case or in a dark room might yield information of great scientific significance; but a plant growing in a farm field or in the wild could yield little or nothing of importance. He thought it praiseworthy to cultivate and identify fungi on petri plates in a laboratory, but to study these fungi with the purpose of controlling the diseases produced by them was an occupation for those who dared not venture on the more difficult roads of pure botany.

This attitude was not confined to botanists, for I recall discussions about the same time concerning the eligibility of certain Sigma Xi candidates. These were at times acrimonious and centered about the propriety of electing to membership men who were primarily engaged in the applied (or impure) phases of science. I mention these incidents not by way of criticism, but merely as a fact to which I shall again refer farther along.

It must be perfectly evident, in this present period of rapidly changing emphasis and objectives, that the continued support of our departments of botany is dependent upon the contributions we can make by way of instruction and research to the welfare and standing of the institutions in which we work. The institutions in turn are dependent directly and unequivocally upon the services they seem to render to their students and their supporters.

During these four decades educational institutions have grown in resources and in student populations far beyond the hopes expressed by their most optimistic administrators. In 1900 there were about 168,000 students in all our colleges. By 1930 the number had passed the million mark, and by 1939 there were one million, four hundred thousand regular students and 430,000 summer school students or, roughly, more than ten times as many as in 1900. Enrolments in federally aided vocational schools of agriculture rose from 31,000 in 1920 to 539,000 in 1939, a seventeen-fold increase in twenty years.

About the beginning of the century there was an average of 11 doctorates in botany conferred each year in the United States. The average to-day is around 110, just ten times as many. A majority of the degrees were, at the beginning, conferred by six institutions; to-day they are being conferred by at least 66 institutions, and the larger departments are granting from 5 to 16 in a single year. In addition, there are now given each year from 20 to 30 degrees that, if one may judge by the titles of the theses, are based on the results of pure botanical research conducted by departments of horticulture, forestry and agronomy.

Forty years ago the quarters occupied by botany departments were certainly not comparable to those occupied by the other fundamental science departments of the same institutions. The old saw that "a stranger can easily locate the botany department by looking for the poorest building on the campus" appeared in SCIENCE and in other periodicals of that time. This is in striking contrast to the modern fireproof buildings and greenhouse facilities in which many departments are housed to-day. In the matter of optical, physical and chemical equipment the departments in our larger institutions and in those associated with the agricultural colleges are now certainly comparable to those of other science departments in the same institutions.

At the time of the organization of the present Botanical Society of America in 1906 there were 116 members; to-day its membership numbers 1,360, of whom 840 are primarily engaged in teaching. In addition, the allied botanical societies list 1,125 plant pathologists, 625 plant physiologists, 500 plant taxonomists, 400 mycologists and 275 bryologists, not to mention botanical memberships in ecological, horticultural and agronomic societies.

The first edition of "American Men of Science" (1906) listed 169 botanists, while the sixth edition (1938) listed 1,677. This list indicates that not only have many doctorates been conferred each year, but it has been possible for the new doctors to find teaching positions in colleges, teachers colleges and universities; and research positions in agricultural experiment stations, private research institutions, land survey offices, game management programs and in forest and soil conservation projects.

Expansion within the fields of agricultural research and of conservation of land and water resources has been even greater than that in the colleges. If you have tramped the eleven miles of corridors in the Department of Agriculture building at Washington and visited the outlying structures at Beltsville, or attempted to contact men in the fourteen scattered buildings that house the Conservation Department you will know what I mean. These Washington offices merely house the centers of stimulation and control of thousands of field men operating in every part of the United States. Indeed, any district in the United States in which there is neither a minor nor a major project of this kind in operation is either unpopulated or very poorly represented in Washington. The government probably has never expended money that added more to our national wealth, health and happiness than the projects fostered by these agencies. In the matter of personnel, these enterprises have been a godsend to many a graduate student and poorly paid instructor of botany.

The latest summary (1938) of the annual resources of American colleges and universities shows that 30 per cent. of their incomes is derived from miscellaneous gifts, collections, sales and auxiliary enterprises, 28 per cent. from student fees, 26 per cent. from state and local government appropriations, 4 per cent. from the Federal Government and only 2 per cent. from endowments. This seems to indicate that 94 per cent. of the financial support received by the average college or university comes directly from the students and from the public that lives at no great distance from the institution. Since in the past the curve of college philanthropies and public support has paralleled the curve of general prosperity, this appears to be a most appropriate time for careful planning, not only by institutions, but by departments and by societies interested in graduate education and research. Will it be possible to continue to secure adequate local and institutional support during the coming years while the Federal Government is trying to prevent the accumulation of surplus funds by those citizens whose incomes are above the subsistence level? This group includes the forty million salaried persons, whose incomes are relatively stable and who probably contribute most to the financial support of collegiate instruction. According to the Brookings Institution the purchasing power of this salaried group in 1942 will be reduced about 25 per cent. below that of the present year.

Most graduate students in our institutions are partly or wholly supported through scholarships, fellowships and assistantships. Since there are usually five to ten applicants for every vacancy it has been possible to select a superior group of fellows and assistants. In those institutions in which such men and women are working as assistants in teaching or in research, the maintenance of these awards has not been a wholly philanthropic procedure. Some of these assistants, on the theory that they learn by doing, have labored as much as forty hours a week, and then pursued their graduate studies in their remaining leisure hours. Graduate assistants have been benefactors to many poorly supported departments and to many a professor who felt that he was overworked or that he should not be bothered with laboratory instruction. Under these circumstances, the holders of assistantships have paid and often overpaid their way through graduate schools. Young men have been willing to serve these apprenticeships either because of their "'satiable curiosity" or because of the promise of positions for which the Ph.D. degree is a prerequisite.

These are some of the outstanding facts concerning the forty years of expansion that may well constitute the *Golden Age of Botany*. Briefly, they indicate that the ten-fold increase in college enrolments, the more recent seventeen-fold increase in federally aided vocational schools and the enormous spread of agricultural and land-use programs have made possible the growth of graduate study in botany. Altogether, about 2,000 doctorates have been conferred during the period, and these doctors have found remunerative positions. We may well take pride in this accomplishment and in the results of the researches to which these men have contributed. But we should also be apprehensive of certain social and educational movements that may materially alter this picture.

The curve of growth eventually flattens, whether it represents the growth of plants, of populations or of post-doctorate positions. It has been a heartening and interesting experience selecting and promoting men during the upward swing of botanical prosperity. Will it be equally thrilling to plan for a change in the direction of the curve?

If I read correctly the handwriting on the federal wall, we in botany are rapidly approaching a plateau of post-doctorate employment. Under these circumstances, are we justified in continuing to encourage so many young men and women to spend four or five graduate years preparing for positions that may not exist?

We know now that the curtailment of most nondefense federal and state projects has begun. We may be pretty sure that college and university incomes will be somewhat less. We can likewise forecast that some of the men now working on so-called emergency projects will be looking for positions in permanent educational and research institutions. The availability of these men will not enhance the chances of employment for inexperienced young doctors.

Some educators predict a great post-war expansion of educational facilities by the Federal Government in the form of vocational schools. Some of my botanical friends have suggested that the larger high schools and vocational schools will absorb the botanical doctors for many years to come.

In this connection we must not be blind to the fact that the administration of these secondary schools is now almost completely in the control of professional educators, very few of whom have had training in the sciences. Most of them have a background of educational philosophies that have been developed neither through valid experimentation nor by scientific methods. Their procedures are based on the inferences of doctrinaires who have theorized about education for "the good life" or for "social welfare."

Field observation of these educators in action suggests that many of them still regard science courses as informative exercises. They overlook the most important contribution that science instruction can make, namely, training in the recognition of relevant data, prolonged student experience in the drawing of correct inferences from such data and the substitution of scientific procedure in thinking for wishful cerebration.

Many professional educators have even less confidence in the study of the subdivisions of science as a contribution to "the good life" and to the salvaging of mankind. Like many lay critics of present-day educational programs they neither understand the objectives of science instruction, nor grasp the fact that however thick the veneer of classical and ethical philosophy has been applied to a hundred generations of men, the gene complements of human beings remain very much the same. Sour apples and sweet alike have been nourished on sugar.

These educators have not been satisfied with the kinds of courses offered either by zoologists or botanists when these courses consisted of learning the names of microscopic structures, their alleged functions and the Darwinian proofs of evolution. They wanted something more directly related to the lives of the students and to community welfare. Their prayer was first answered by various zoologists who offered unit courses and wrote text-books of biology. One of the reasons why many schools adopted biology was that the biology books chose to present a variety of units of popular appeal. They emphasized food and energy, personal hygiene, sanitation, familiar plants and animals, interdependence of organisms, conservation and the relation of each of these topics to human affairs. Many of these unit courses were informative, but they were more in the nature of propaganda than of science. Since they served to acquaint students with a variety of pertinent biological questions and answers, school administrators seized upon them as a way to replace the former evolutionary courses of botany and zoology.

In these biological catechisms the botanical units were usually very sketchy and occupied only a fourth or a fifth of the books. The principal emphasis was placed on animal biology because these units formed a basis for the further study of human anatomy and physiology. They were also better adapted to be taught part time by the athletic coaches. Where these biology courses went into the schools, botany came out, and only the larger schools provided a supplementary course in plant science. Because of the relation of biology and zoology to medicine, many of the smaller colleges find it profitable to offer premedical curricula, and here again instruction in botany appears to be a luxury.

Because of the demand for biology teachers, colleges of education have asked that biology courses supplant the more specialized botany and zoology courses. In part this is a method of cutting down on the time allotted to subject-matter studies; in part it is a method of providing the student with a ready-made pattern of biology instruction at the college level, that he can apply immediately and with little effort in the sphere of the secondary school. Educators assume that plants and animals are so similar in physiological processes, cell structures, essentials of reproduction and heredity that they can not see why we should insist on dividing the instruction into two "compartments." The answer is too obvious to be discussed here.

Survey courses afford another economical means of imparting science information to large groups of students. They bear the same relation to laboratory and field botany courses that seeing the movies of football games bears to participation in the game. They may stimulate interest in science, but the students can not acquire the habit of scientific thinking by these methods any more than they can acquire the techniques of playing football by looking at the movies.

In times of financial stress, however, administrators sometimes decide upon course offerings without benefit of consultation. Arts colleges, as in the past, may grasp the straw of premedical studies and drop all botanical instruction. Teachers' colleges that insist on the teaching of biology followed by supplementary courses on birds, insects and human physiology will find zoologists far more useful than botanists.

Granting that there do exist secondary schools in which some of the teachers have doctor's degrees, many educators are at the present time definitely opposed to the employment of teachers who have specialized to this extent, unless perchance the degree was conferred for studies in the teaching of biology. One state administrator made this clear when he said that science Ph.D.'s should be kept out of secondary schools because their training had made them interested in science rather than in the education of boys and girls. This attitude may be radically changed, however, when most of our superintendents and principals themselves are ornamented with doctor's degrees.

Retirement funds and pensions were lauded at the time when private foundations and state governments established them. Pensions were supposed to encourage teachers to devote their lives to instruction in spite of the comparatively low salaries. In general this effect has been attained. However, there is a demon in every benign formula. College administrators whose institutions were contributing to these funds soon began to study the actuarial tables to see how much of their incomes would be absorbed by the promised pensions. Some institutions found that they were harboring too many men approaching the retirement age. If there seemed to be no way to enlarge their budgets the institutions have two other ways to meet the actuarial situation. One is to encourage older men to leave when they receive an offer elsewhere, and replace them with beginners; the other is to limit all new appointments to young men.

This procedure will literally put numerous competent, but older men on the spot if they should lose the positions they now hold. None of these colleges now wishes to increase its liabilities when it can decrease them by hiring beginners at subsistence salaries. In general, these beginners can be most easily recruited from those of their own recent graduates who have not secured positions elsewhere and this leads to servile inbreeding. Prospective pensions also have been factors in the release of older faculty men, regardless of their health and competence on various flimsy pretexts, and the substitution of young men. Pensions seem to favor the young doctors.

Returning now to the so-called "lesser minds," or to those men who have always been interested in the applications of botany to agriculture, horticulture, forestry and conservation—these are the socially minded botanists, and the results of their work are apparent everywhere. They have made it possible for two blades of grass to grow where none grew before, and they have transformed the practices in every art related to plant growth. They have enriched us with fruits, grains, vegetables and ornamentals from other continents; they have provided us with new and better varieties; they have discovered methods of preventing or controlling parasitic devastations, and they have found new ways to augment the growth of plants and increase the returns from the land.

One of the results of the cooperation of the "lesser minds" with the agricultural and conservation interests, with the various grower's associations and with the public, has been an increasing demand for the support and continuation of their own research projects. A second result has been that they have furnished the only basis for the continuation of research by the esoteric botanists who looked askance at them not so many years ago. How large an audience and what kind of equipment would these academic botanists have to-day were it not for the cooperation of the botanists in the public service and the enthusiasm they have transmitted to young men looking for a career?

Another consequence of the activities of the "lesser minds" has been the securing of funds for experimentation and research on a scale never dreamed of by the older botanists. They have become the principal source of information about the growth of plants out-of-doors. They have transformed the old indoor botany, with its "bean, pea and popcorn" demonstrations in Wardian cases, into a science of plants as they grow in fields and orchards, as well as in forests, grasslands and deserts. At the same time, they have probably contributed as much to botanical theory as have the occupants of the ivory tower.

I have briefly sketched some of the changes in point of view that have occurred during the past four decades, and I have pointed to some of the dangers that attend the impending overproduction of doctors in the field of botany. The present year-to-year increase must sooner or later lead to many personal catastrophes.

We the members of the Botanical Society constitute the only group that can anticipate and ameliorate this situation. By mutual cooperation we can suggest more intelligent preparation for graduate study of botany, and we can insist on a higher and a broader foundation for admission to candidacy for the Ph.D. degree. By this method alone we can also gradually adjust the number of graduate assistants and fellows to the number that can secure permanent appointments upon graduation.

If, in the near future, an outlet for our doctors develops in the secondary schools we should be prepared to certify that every doctor can not only meet the State Board requirements, but that he has a background in the allied sciences that will enable him to visualize the field of plant science as a whole and that his perspective is not limited to the narrow confines of his research interest.

All that I have said up to this point was written a month ago before we became active participants in the life-and-death struggle between Hitlerism and Democracy. The future is even more complicated than it was a month ago. The implications of an all-out war further emphasize the need for a new qualitative and quantitative appraisal of our procedures both in the field of graduate studies and in the enlistment of continued public support through the education of undergraduate students.

In the face of the sacrifices of our young men, the dissipation of our natural resources and the threat to all our ideals of "life, liberty, and the pursuit of happiness," the future of our profession may seem trivial and irrelevant. Nevertheless, there will be an end to this war just as surely as there was a beginning, and now is the time to plan for the aftermath.

EVOLUTION AND KNOWLEDGE

By Professor **WILLIAM E. RITTER**

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I AM incited to the following remarks by the difference, concerning the evolution theory, between R. Goldschmidt and F. B. Sumner as manifest by Sumner's recent article "Is Evolution Inscrutable."[1] These zoologists are fellow colleagues of mine (or would be if I were not a mere emeritus) in the University of California, and both have my high esteem, personal and scientific. And I make the remarks with less hesitation in that I do not pretend to mediate the seeming difference between them.

If we biologists—especially the zoologists among us—look at ourselves closely, it strikes me that most, if not all of us, would see that we have steered a rather queer intellectual course relative to the evolution problem since Darwin gained, for the general theory of it, acceptance by almost every student well grounded in the fields of research in which it chiefly lies.

And perhaps the queerest, if not the most unfortunate, thing about it is that so much of our procedure has reversed the order, so far as knowledge is concerned, followed by Darwin in working out the theory.

It would seem quite uncalled for to remind any educated person to-day of the origin of the theory from Darwin's experiences as the naturalist of the famous *Beagle* voyage. But there are aspects of his experiences, as an observer of the vast and varied phenomena he came upon, that call for a sort of attention that they get all too little of, even by many of the most highly educated persons.

For instance, I was rather shocked lately by being called down quite emphatically in a group of natural scientists, for quoting Darwin's well-known statement that he worked on true Baconian principles and "without any theory collected facts on a whole scale."[2]

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[1] SCIENCE, May 30, 1941.

[2] "Life and Letters," I, p. 68.

Although the subject was touched only incidentally, the essence of the group's view seemed to be that no real scientist ever begins a real research without a theory of some sort as a starter.

Yes, I am now convinced by my later, more thorough reexamination of Darwin's attitude toward nature and his methods of research that he was entirely right in what he said about his procedure that led him not only to his general theory, but to all his special hypotheses in connection with it.

A secondary but yet important thing here is the naiveté, the literally child-like confidence the man (like nearly all persons eagerly devoted to the study of nature) had in thoroughly verified sense perceptual knowledge of the phenomena under investigation.

Could anybody be so egregiously foolish as to contend that Darwin did not see, that is, observe by the sense of sight, the various fossils he came upon in South America *before* he guessed, that is, made hypotheses, that they were once parts of creatures that lived long ago; and that those creatures might be the ancestors of creatures he had observed as present-day inhabitants of the region?

And recall the extent of observational study he had to make on the birds, especially of the Galapagos Islands, before he could theorize about their kinship with birds of the rather distant South American continent.

A particularly crucial factor comes into the situation with the endlessly debatable idea of "cause." For the evolution problem, the fact of "variation" was a poser for Darwin as it has been for every one else who has observed widely and thought earnestly on the nature and origin of the kinds or species of plants and animals. And the great figure the facts cut in Darwin's theory is too familiar to need dwelling on. The cardinal point for us here is that Darwin just took the facts of variation as observed by him and innumerable other trustworthy naturalists. Regardless of the cause or causes that produced variations, *there they are,* he said in substance over and over again, *amply verified and readily verifiable by observation.*

Not by any means was he disregardful of the problem of their causes. But so innately certain was he of the necessity of their being established as observed facts before the question of their cause or causes could even be asked, that he justifiably saw no reason why they should not enter as factors into a general theory of the origin of species while yet the causal question of the variations was still under investigation.

For one thing, the very idea of such a thing in living nature as "species" Darwin knew, as do all other persons thoroughly devoted to the study of this portion of nature who are usually classed as "naturalists," rests at bottom on sense perceptually acquired facts about the make-up of this portion of nature.

So the problem of the cause or causes of variation would be only a part of the larger problem of the cause or causes not only of species, but also of the existence of living nature.

I find nothing in Darwin's writings that seems to me more convincing of his faith (I do not think this word is too strong) in the reality of nature generally, and in the basic role of sense perception for gaining knowledge and understanding of that reality, than in one of his letters to Asa Gray. The sentence that appears to me crucial, but to have received too little attention, is this: "Personally, of course, I care much about Natural Selection; but that seems to me utterly unimportant, compared to the question of Creation or Modification."[3]

Read in the light of all his work this is only another, and a bit more the crucial, way of saying that as opposed to the doctrine or theory of a *supernatural* cause of living nature with its maze of different kinds of individuals, Natural Selection as a causal theory of it is "utterly unimportant" as compared with a theory that *natural* causes of some sort have produced the modifications, and changes of kinds into other kinds as they are presented for sensory observation in endless profusion.

But it was only when Darwin came to deal specifically with the nature of man in the light of the general theory of evolution, that his faith in, and reliance on, such observation becomes manifest in all its concreteness and depth. Here it is most fully displayed in "The Expression of the Emotions in Man and Animals." For here he undertook his most systematic and thorough-going comparison of man with his closest subhuman mammals on the basis of one attribute (the "emotions") common to both. One thing about this research is particularly significant for these remarks. That is its example of one aspect of what research in "natural history" included for Darwin, when applied to man. This is indicated, for one thing, by his making the problem of "causes" strictly subordinate to, and dependent on, facts of observation. Thus, after speaking about various difficulties encountered in such a research as he was here entering upon; and mentioning "the observation of infants" as one means of overcoming the difficulties, he writes: "But there remains the much greater difficulty of understanding the cause or origin of the several expressions and of judging whether any theoretical explanation is trustworthy" (p. 20).

Considerably more of the paragraph in which this occurs is much to our point—but we pass it. A particularly significant thing in connection with the causal question is the little reference to natural selection in the whole book. The term has no place in the index.

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[3] "Life and Letters," II, p. 163.

Another sharp indication of the place evolution, as compared with natural selection, had in Darwin's thought is given us on the same page as the above quotation. "With respect to my own observations," he says, "I may state that they were commenced in the year 1838. . . . At the above date, I was already inclined to believe in the principle of evolution, or of the derivation of species from other and lower forms."

No one should need to be told that the "above date" was many years before the hypothesis of natural selection had entered his mind.

But Darwin's faithfulness to sensory observation as an essential preliminary to all theory about evolution, finds its most crucial illustration at a specially recondite point in "The Descent of Man." This we shall notice presently. But it seems desirable to glance at one or two simpler illustrations, prefacing the glance, by noting that the procedure in the entire book is really illustrative of the principle. Having reached the general theory as to living nature, his purpose here is to consider whether the observational facts of the particular species, man, are such as to justify the theory that he too originated as species in general almost certainly have originated—and are still originating.

The whole of Part I is devoted to evidence available from observational studies of man as he exists now or has existed in the recorded past, that which agrees with the observational evidence basic to the general theory of evolution, especially as applied to the higher portions of the animal world. That is to say, it is not a theory of man's origin at some remote time in the past that Darwin starts with, but an extensive presentation of observed facts of what he is at present.

Thus notice some of the items listed in the first chapter of the first part: "Nature of the evidence bearing on the origin of man; Homologous structures in man and the lower animals . . . muscles, sense-organs, hair, bones, reproductive organs, etc." These are such commonplace matters that to one absorbed in the great philosophic problems of man's nature and origin they may seem too trivial to deserve serious attention.

Accordingly we pass to the "specially recondite point" referred to above—with the reminder that it occurs in the same Part I of the book. That is to say, for Darwin it belonged to the same category of sensory observational knowledge as the trivial stuff quoted above. The point is in Chapter IV, which starts off with the discussion of "The moral sense." "'This sense,' as Mackintosh remarks, 'has a rightful supremacy over every other principle of human action.'" Then follows immediately the "recondite point" referred to. It contains Darwin's own statement of what the supreme "principle of human action" is: "It is summed up in that short but imperious word ought, so full of high significance. It is the most noble of all the attributes of man, leading him without a moment's hesitation to risk his life for that of a fellow creature; or after due deliberation, impelled simply by the deep feeling of right or duty, to sacrifice it in some great cause."[4]

It would have been well had Darwin cited a few well-known observed and recorded examples of the applications of the "imperious word"; and of the sacrifice of one's life in "some great cause." But it probably did not occur to him that any of his readers would question either the recognition of the imperiousness of the "*ought*" or the "deep feeling of right or duty"; or of the knowledge of these having been reached in part through sense-perceptual experiences.

However, had he gone into the matter more specifically, more analytically, he might have clarified his conception that the "most noble of all the attributes of man" belong to him as a product of natural evolution and hence are subjects to be studied and understood by the method of "Natural History"—by the methods, that is to say, the initial steps in which are sensory observations.

In the very same paragraph with these statements we read:

> Immanuel Kant exclaims, "Duty! Wondrous thought, that workest neither by fond insinuation, flattery, nor by any threat, but merely by holding up thy naked law in the soul, and so extorting for thyself always reverence, if not obedience; before whom all appetites are dumb, however secretly they rebel; whence thy original?"

It is noteworthy that Darwin quotes this from the "Metaphysics of Ethics" (translated by J. W. Semple, Edinburgh, 1836, p. 136.)

A comprehensive study of "The Descent" and the "Expression of the Emotions" leaves not a scintilla of doubt—with me at least—that as Darwin wrote this his own answer ("Evolution" as he conceived it) to Kant's "whence thy original?" was in the back of his mind.

But momentous as this is in its implications it is not what specially concerns us here. Our main concern is the knowledge problem involved. This leads us to words in the next paragraph of the same chapter. After speaking almost apologetically of why he felt he could not avoid touching the great problem of morals, he tells us: "As far as I know, no one has approached it exclusively from the side of natural history."

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[4] "Descent," 2nd ed., p. 148.

Here we have a striking example of what may well be called Darwin's naiveté. In pitting his natural history method against the *a priori* method employed by Kant in his doctrine of the categorical imperative as an interpretation of the "imperious word ought," and of "Duty! wondrous thought," Darwin seems to have realized very dimly if at all that he was running head-on into one of the worst tangles of logic as a subject for general treatment. The tangle referred to is that of the relation between the two portions of logic known as inductive and deductive. More specifically stated, it is the relation between sense perception and observation on the one hand, and reason and thought in all their vast scope and power on the other hand. Darwin seemingly felt perfectly certain of the essentiality of both—of their inseparableness at bottom—for getting knowledge by the methods of natural history as he conceived and practiced those methods in all his work. Hence it apparently did not occur to him that anybody would be confused by his approach to the moral problem including the idea of "Duty! wondrous thought," as he was now approaching it.

But the more acquainted I become with the flood of discussion, by friends and enemies of the Darwinian theory of evolution, the more I am impressed by the extent of the confusion, even contemptuous hostility, on this very matter.

I am now convinced that in probably no other connection, in all Darwin said about evolution, is there more to justify the recent conclusion reached by a few students and pungently expressed by Sir Arthur Keith, that even the best of biologists and historians have not yet accepted evolution "beyond their lips."

It may possibly add something to this view if I say that my own efforts during the last decade or more to understand the human species in the entire scope, physical, mental and spiritual, of its nature, had led me to essentially the same conclusion before I came upon Sir Arthur's statement.

It now seems to me impossible for anybody whose technical training and general experience enables him to grasp what Darwin meant by, and included in, natural history, to fail, after a thoroughgoing study of Part I of "The Descent" and the whole of "Expression of the Emotions," to recognize the full justification of Darwin's confidence in both the inductive and deductive sides of logic as defined above.

As something of an indication of his fidelity to reason, thought and the rest of what the deductive side of logic chiefly depends upon, notice the list of topics treated in Chapter III of Part I: "The difference in mental powers between the highest apes and the lowest savage, immense—Certain instincts in common—The emotions—Curiosity—Imitation—Attention—Memory—Imagination—Reason—Progressive improvement—Tools and weapons used by animals—Abstraction, Self-consciousness—Language—Sense of Beauty—Belief in God, spiritual agencies, superstitions."

This list of topics and the fifty-page discussion of them should, of course, be read not as though written by a full-fledged psychologist or philosopher of to-day, but by a full-fledged naturalist of more than three quarters of a century ago.

This list shall serve to bring these "remarks" of mine—already run far beyond what I expected—close to an end. The crux of the remarks that I've been trying to reach all the while is this: Although Darwin says nothing of the sort expressly, the implications of much that he says are unmistakable (to me at least) that the problem of knowledge itself would be for him part-and-parcel of the problem of evolution. The much-used phrase "natural knowledge" would not for him have the usual limited meaning of knowledge of external, sense-perceptual nature, but would include knowledge of knowledge itself as one aspect of the grand sweep of nature in its unified wholeness. Then since the theory of evolution is a product of, and is embedded in, natural knowledge; and this as a whole is produced by men and is constantly being reproduced, revised, and improved by the observations and reasonings of men actually living at any given time, this very year for instance, no causal or other factors of the evolutionary process can rightfully be conceived as lying outside the scope of nature. That this is true Darwinism, not only as to Evolution but as to nature in general, I trust my sketchy remarks have made to appear highly probable at least, to my readers.

Finally as to the relevancy of such a view to the issue between Goldschmidt and Sumner: Sumner's solicitude expressed in the last sentence of his article lest Goldschmidt is leaving "naturalistic biology in a most embarrassing position" does not disturb me nor, I think, any adequately understanding Darwinian. This is so because nothing in the framework of a naturalistically conceived biology can rightly be conceived otherwise than as naturalistic. The Darwinian theory of evolution is only one aspect or phase of the Darwinian theory of the all-inclusiveness and all-adequacy of nature.

Goldschmidt's causal theory of evolution must, of course, according to the standpoint of these remarks, be brought to the bar of natural knowledge as defined above—just as is the case with any other such theory.

OBITUARY

ALEXANDER LOWY

1889-1941

Dr. Alexander Lowy, professor of organic chemistry in the University of Pittsburgh, died in The Western Pennsylvania Hospital on December 25, 1941, after an illness of about four months.

Dr. Lowy was born in New York City on March 31, 1889, the son of David and Fanny (Weiss) Lowy. He obtained his bachelor of science degree from Columbia University in 1911, the master of arts in 1912 and the doctor of philosophy degree in 1915. His major work was in the field of organic chemistry under Columbia's Professor Marston T. Bogert, leader in the field of organic chemistry and president of the International Union of Chemistry. On December 23, 1915, he married Dora Landberg of Brooklyn.

Dr. Lowy was assistant in electrochemistry in Columbia University from 1912-1915. He taught in the high schools of New York City from 1915-1918 when he became professor of organic chemistry in the University of Pittsburgh with which he was associated until the time of his death. During the past summer he was exchange professor in the University of Southern California. Dr. Lowy was the holder of numerous United States patents. He was a recognized authority in the field of protective chemicals, having invented methods for the safeguarding of banks and vaults. He also made important contributions in the field of dyestuffs and was a pioneer in electro-organic chemistry, to which he contributed numerous researches. Dr. Lowy, with Dr. Benjamin Harrow, of the College of the City of New York, was the author of *A Text-book of Organic Chemistry,* which is in use in over 125 colleges and universities in America. This text-book has gone through many revisions. Each revision included the latest developments in the field of organic chemistry and the most modern charts and devices. This tendency was characteristic of the senior author. A companion volume to the text-book is *A Laboratory Manual of Organic Chemistry* with Dr. Wilmer E. Baldwin, assistant professor of chemistry in the University of Pittsburgh. This also has had extensive adoptions. Dr. Lowy contributed the chapter on organic chemistry to Rogers's *Manual of Industrial Chemistry.* Alone and with his research students he was the author of over seventy research reports and scientific papers which have appeared in technical journals since 1919. Dr. Lowy was a member of the American Chemical Society and a past chairman of the Pittsburgh section. He was a member of the American Electrochemical Society and its vice-president from 1930-1933 and again from 1939-1941. He was chairman of the committee on publications of this society from 1931 to 1941. He belonged to the honorary science societies, Sigma Xi and Phi Lambda Upsilon. He was an honorary member of Sigma Alpha Mu fraternity.

In the summer of 1929, Dr. and Mrs. Lowy visited England and continental Europe, where Dr. Lowy made a study of the universities and industrial establishments. He lectured extensively and addressed many of the sections of the American Chemical Society. It was as a teacher that Dr. Lowy reached his pinnacle. No effort was too great to provide what was best for the student. The painstaking care with which material was presented left no question regarding accuracy. He was exacting in the student's performance, but at the same time tolerant of the individual's difficulties and ever willing to lend the student a hand and help him, not only in his studies but in his private problems. Dr. Lowy had no hobbies. His only pleasure was his work except during recent years when he enjoyed his small farm in Gibsonia, Pennsylvania, where he and his family spent the summers. In the University of Pittsburgh he was a member of important committees and was faculty chairman of registration.

Alexander Silverman

University of Pittsburgh

ORIN F. STAFFORD

Orin F. Stafford, chairman of the Chemistry Department of the University of Oregon and dean of science and of the Lower Division, died at Eugene, Oregon, on September 17, 1941, after a painful illness of two months.

Professor Stafford was born at Hillsboro, Ohio, on February 7, 1873. He moved with his parents to Kansas in 1885, and in 1900 received the A.B. degree from the University of Kansas and in 1902 the A.M. degree. In 1900 he was appointed instructor in chemistry at the University of Oregon. In 1902 he became assistant professor and in 1906 was promoted to full professor and head of the department. He became dean of science in 1934.

While at Kansas Stafford was assistant to Dr. E. C. Franklin and participated in the pioneer work on solutions in liquid ammonia. Thus began an intimate friendship between the two men which continued throughout subsequent years.

Professor and Mrs. Stafford spent the year 1908-09 in Europe, where he did graduate work at the University of Berlin under Dr. Walter Nernst. During the four years from 1918 to 1922 he was on leave of absence in Boston and Kingsport, Tenn., developing his invention for the autogenous distillation of wood.

This invention and subsequent work on the subject of wood waste brought him wide recognition as an authority on wood distillation and waste wood utilization and, up to the time of his illness, he carried on an extensive correspondence concerning the problems involved in this interesting field.

He was active as a member of scientific organizations. He rarely missed meetings of the local chapter of the American Chemical Society. He served as president of the Oregon section and as its representative as councilor of the national society. He was president of the Oregon chapter of the Sigma Xi and was prominent in the councils of the local chapter of Phi Beta Kappa. He was a member of the program committee of the Pacific Coast Division of the American Association for the Advancement of Science. At the time of his death he was one of the inspectors for the committee of the American Chemical Society for accrediting institutions for the training of chemists. He was also the chemistry representative on the basic science examining committee for licensing physicians in the State of Oregon. Locally he was president of the Eugene Rotary Club, a member of the Round Table Club, a member of the Eugene School Board and one-time president of the Boy Scout Council.

Though he was not formally trained as an engineer he possessed the instincts of one and was always interested in chemical engineering problems. The practical more than the purely theoretical implications of chemical discovery always intrigued him. However, in spite of his scientific, academic and community activities his primary concern was always the interest of his students. He was a patient, thorough and painstaking teacher. He would lay aside any task to answer the appeal for help from any struggling student. In return he was accorded not only the respect of his students but their lifelong friendship as well. Professor Stafford's contributions to the literature of chemistry, while not particularly voluminous, were valuable and substantial and reflect the breadth of his interests, ranging as they did from the mineral resources of Oregon and the composition of the saline lake deposits to the molecular weight of sulfur and solubilities in acetamide.

He held memberships in the following societies: American Association of University Professors, Phi Beta Kappa, Sigma Xi, American Institute of Chemical Engineers, American Chemical Society, and he was a fellow in the American Association for the Advancement of Science.

His hobby was flowers and shrubs. He spent early morning and evening hours in his garden. After the onset of his last illness he officially retired from active duties and was looking forward to recovery and freedom to more fully enjoy his outdoor activities.

Professor Stafford leaves his wife, Mary Elizabeth Stafford, daughter of the late Dean John Straub; his two sons, both of whom are married and reside in Eugene, Howard Straub Stafford and John Edward Stafford; one daughter, Miriam Stafford Hamilton, of Wenonah, N. J., and one grandson, Robert Stafford Hamilton.

F. L. SHINN

EUGENE, OREGON

RECENT DEATHS

DR. HEBER DOUST CURTIS, head of the department of astronomy at the University of Michigan and director of the observatory, died on January 8 at the age of sixty-nine years.

STEWART PATON, consultant in mental hygiene and lecturer in psychiatry at the Johns Hopkins University, died on January 7 at the age of seventy-six years.

Nature records the death of Dr. H. Ettringham, president of the Royal Entomological Society in 1931–1932, on November 26, at the age of sixty-eight years; of Dr. Walcot Gibson, formerly director for Scotland of the Geological Survey of Great Britain, on November 28 at the age of seventy-seven years; and of Dr. F. Stang, from 1921 to 1927 rector of the University of Oslo and president of the Nobel Committee of the Storting, who was known for pioneer work in comparative research in human culture, at the age of seventy-four years.

SCIENTIFIC EVENTS

WAR WORK OF THE CANADIAN RESEARCH COUNCIL

ACCORDING to the official report, scientific research in Canada since the war began has been directed almost wholly to the solution of new and urgent problems arising out of the war. Dr. C. J. Mackenzie, acting president of the National Research Council, points out that the council, the universities, members of the scientific and engineering professions and the technical staffs of industrial firms are pulling together towards the common goal, united as never before in the single purpose of winning the war.

In the National Research laboratories at Ottawa work has been expanded in several directions because of the war. In the chemistry and biology divisions especially the selection and testing of suitable materials for the use of the armed forces has been a major problem. Specifications for materials normally bought in England have had to be revised to conform with Canadian practice. All kinds of supplies have had to be tested to determine whether they are acceptable according to required standards. Technical advice has been given as requested by the services in the specialized fields of science in which the council members are trained. Food storage and transport under war conditions presented many difficulties. Lack of refrigerated space and indeed lack of ocean shipping space made it necessary to devise new methods of handling perishable foodstuffs. The tremendous increase in volume of merchandise being shipped and the limited number of cargo vessels available require that the best possible use be made of every inch of space.

In physics, electrical and mechanical engineering, the design and development of new detecting devices to locate aircraft, submarines, mines and other enemy equipment have been carried forward with much success. Testing of engines, hulls, aircraft and hosts of other items of equipment used in mechanized warfare has been done on a large scale.

THE ELLA SACHS PLOTZ FOUNDATION FOR THE ADVANCEMENT OF SCIENTIFIC INVESTIGATIONS

During the eighteenth year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigations, sixty-seven applications for grants were received by the trustees, forty-nine of which came from seven different countries in Europe, Asia, North and South America. The total number of grants made during this year was thirty-five, one of these being a continued annual grant. In the eighteen years of its existence the foundation has made four hundred and twenty-nine grants which have been distributed to investigators throughout the world.

For the present, researches will be favored that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery. Grants may be used for the purchase of apparatus and supplies that are needed for special investigations, including technical assistance, but not for providing apparatus or materials which are ordinarily a part of laboratory equipment. Stipends for the support of investigators will be granted only under exceptional circumstances. The maximum size of grants will usually be less than $500.

Applications for grants to be held during the year 1942–1943 must be in the hands of the Executive Committee before April, 1942. There are no formal application blanks, but letters asking for aid must state definitely the qualifications of the investigator, an accurate description of the research, the size of the grant requested and the specific use of the money to be expended. In their requests for aid, applicants should state whether or not they have approached other foundations for financial assistance. It is highly desirable to include letters of recommendation from the directors of the departments in which the work is to be done. Only applications complying with the above conditions will be considered.

Applications should be sent to Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Massachusetts.

THE NUTRITION FOUNDATION, INC.

According to an announcement recently made by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, fifteen leaders in the U. S. food industry are sponsoring a Nutrition Foundation to help to build American health and energy.

Dr. Compton has been elected chairman of the board of trustees of the foundation—which will be operated on a non-profit basis to distribute freely all scientific discoveries in foods and diet. The Nutrition Foundation, Inc., has been incorporated at Albany under the membership corporations law of the State of New York. The fifteen prominent manufacturers, who have contributed an operating fund amounting to hundreds of thousands of dollars for the establishment of the first cooperative scientific research laboratories created by the food manufacturing industry, are the American Can, Beechnut, California Packing, Campbell Soup, Continental Can, Corn Products, General Foods, H. J. Heinz, Libby McNeill and Libby, National Biscuit, Owens-Illinois Glass, Quaker Oats, Standard Brands, Swift and United Fruit.

The board of trustees will include officers of these companies, together with Americans prominent in government, business and national life, as well as representatives of other companies which later may join the foundation. Leaders in scientific and related fields will be invited to serve in various important capacities in the work. Dr. Compton stated that the Nutrition Foundation had been underwritten by a group of leading manufacturers in the food industry and allied fields as a needed public service. The purposes of the new organization are as follows:

> (1) To develop and apply the science of nutrition in its fundamental conception and practical significance as a basic science of public health;
>
> (2) To aid the food industry in appropriately solving its general and individual problems relating to that science; and
>
> (3) To do so by lawful and effective means, as a public institution operated on a non-profit basis and dedicated to improve the food and diet and thus to better the health of the people of the United States of America.

THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE third annual report of the National Foundation for Infantile Paralysis, containing a broad outline of the work which was sponsored by the foundation during 1941, was issued on January 12. Basil O'Connor, president of the foundation, states that the task of the National Foundation in attempting to conquer infantile paralysis and to ameliorate its effects has fallen into two main divisions: national and local. The National Foundation acts in the national field chiefly as a research grant-making, coordinating and educating agency. Its activities are divided into five divisions: virus research, nutritional research, after-effects research, epidemic aid and education. To carry out this program during the past fiscal year, $807,131.50 was spent as follows:

> For virus research, grants and appropriations totaling $186,565.06 were made to universities, schools of medicine, hospitals, research foundations and state departments of health.
>
> For studies on nutrition, $67,969.17 was granted.
>
> For after-effects research, included in which is the work of Miss Elizabeth Kenny and fifteen other grantees, $285,572.54 was authorized.
>
> For epidemic aid, clinics, respirators, splints and frames, nursing and medical help to communities, organizations and institutions during emergencies, $89,048.13 was spent.
>
> For education, $154,091.11 was expended for nursing and physiotherapy instruction, publications, motion pictures and health exhibits.

During the past year over a thousand new chapters composed entirely of volunteers were formed at a cost to the foundation of $23,885. To-day 1,500 counties are served by chapters. Chapters aided needy infantile paralysis victims regardless of their age, race, color or creed. This assistance included financial help for the purchase of orthopedic equipment and services and for the payment of medical, hospital and nursing expenses. For these purposes $1,137,222 was left with the chapters in 1941. Volunteer groups also aided doctors and public health officials in carrying out the epidemic program in Alabama, Georgia, Mississippi, Pennsylvania and in many other emergency areas.

PRESENTATION TO WILFRED HUDSON OSGOOD

THE sixty-sixth birthday of Dr. Wilfred Hudson Osgood, of the Field Museum of Natural History, of whose staff he has been a member for thirty-two years, has been memorialized by the publication of a testimonial volume of four hundred pages.

According to the official statement the book opens with two dedicatory articles. One is by Stanley Field, who became president of the museum in 1909 (in the same year that Dr. Osgood joined the staff) and has continued at the head of the board of trustees ever since. The other is by Major Clifford C. Gregg, director of the museum. Mr. Field and Major Gregg both express their appreciation of Dr. Osgood as a man and of his scientific work, and give reminiscences of his career. In the pages that follow the biographical sketches appear eleven scientific articles by zoologists on the staff of the museum and by colleagues of Dr. Osgood in the study of mammals from other institutions both in this country and abroad. The book, entitled "Papers on Mammalogy," appears as Volume 27 of the Zoological Series of the museum.

A specially bound copy was presented to Dr. Osgood on December 8, simultaneously with the beginning of international distribution of the edition of several hundred copies to scientific institutions and scientific workers.

Dr. Osgood's scientific career covers a period of forty-four years. A graduate of Stanford University, he took his Ph.D. degree at the University of Chicago. For twelve years prior to going to Field Museum, he was a biologist on the staff of the U. S. Biological Survey. He joined the staff of Field Museum on July 1, 1909, as assistant curator, and became chief curator of the department of zoology in 1921, continuing in that capacity until his retirement from active service on December 31, 1940. Since his retirement he has retained his association with the museum as curator emeritus, and has continued the pursuit of various important researches with undiminished enthusiasm.

Dr. Osgood has led many expeditions for Field Museum, in South America, Africa and Asia. Among the most important were the Marshall Field Expedition to Chile in 1922–23, the Magellanic Expedition of Field Museum which in 1939–40 explored and collected in the southernmost reaches of South America rounding out the explorations of 1923, and the Chicago Daily News-Field Museum Abyssinian Expedition in 1926–27. He personally financed and conducted an expedition to French Indo-China in 1937.

In the closing paragraph of his preface to the testimonial volume, Stanley Field, president of the museum, writes: "The great growth of Field Museum has coincided with Dr. Osgood's régime as chief curator of zoology. This growth has been two-fold, in the direction of exhibition on one hand and in the development of the scientific collections and researches based on them on the other. No one in Field Museum's organization has played a more active or more effective part in this vital developmental period of the museum than has Wilfred Hudson Osgood."

AWARD OF THE DAVY MEDAL OF THE ROYAL SOCIETY TO DR. DAKIN

AT the anniversary meeting of the Royal Society at Burlington House on December 1, the Davy Medal was presented to Dr. Henry Drysdale Dakin, of Scarsborough, New York. Sir Henry Dale in making the presentation spoke as follows:

Dakin began his researches in the field of biochemistry early in the present century. At that time, in comparison with knowledge of the end-products of metabolism, relatively little was known about the chemical activities of the living cells of the animal body. His work has made very important additions to knowledge of the intermediary changes produced by these activities, and also of the chemical structure of natural components of the tissues.

One side of Dakin's work has dealt with enzymes of the animal organs. He was the first to show that such an enzyme will attack at different rates the two optical isomers in a racemic mixture. With Kossel he discovered the enzyme arginase, with its important rôle in the production of urea from arginine. Later he discovered the enzyme glyoxalase, the wide distribution of which in the tissues must indicate some important though still undefined function in carbohydrate metabolism.

In connection with the intermediary metabolism of fatty acids, Dakin produced the first convincing evidence of oxidation at the β-carbon atom as the first stage of their utilization by the body, and showed that this type of oxidation can even be reproduced *in vitro* by the action of hydrogen peroxide.

Dakin's work on the chemistry of the proteins has included a method of partial racemization, bringing subtle differences of molecular pattern into view, which could be related to specific antigenic differences. He also introduced a method of separation which enabled new hydroxyamino acids to be recognized, and raised much nearer to unity the proportion of a protein molecule accounted for as known amino-acids. At a wide interval of years, Dakin has made two notable contributions to the chemistry of hormones. In 1905, he was responsible for the first published artificial synthesis of a hormone, adrenaline. In 1936 he described the isolation from liver of a substance which is, at least, a principal factor in the important effect of liver extracts on pernicious anemia.

Working in France during the War of 1914–18, Dakin introduced the use of a buffered hypochlorite solution for irrigating infected wounds. Later, on a ship bringing the sick and wounded from Gallipoli, he made a similar solution by direct electrolysis of sea-water. Another war is reviving the use of such preparations to meet the same and other needs.

Though Dakin has worked in a private laboratory, with but rare collaboration and no pupils, his work has exercised a wide and powerful influence on the growth of biochemistry and on the strengthening of its links with organic chemistry.

SCIENTIFIC NOTES AND NEWS

THE Charles Reid Barnes life membership of the American Society of Plant Physiologists has been awarded to Dr. Benjamin M. Duggar, of the University of Wisconsin, "in recognition of his outstanding contributions in the field of plant physiology." The award was presented at the annual dinner held during the eighteenth annual meeting of the society at Dallas.

THE Thomas Burr Osborne Medal in cereal chemistry of the American Association of Cereal Chemists has been awarded to Dr. Ross Aiken Gortner, chief of the division of biochemistry of the University of Minnesota, "for distinguished services in conducting research and training students." The medal will be presented at the annual meeting of the association next May.

DR. G. MARSHALL KAY, assistant professor of geology, Columbia University, has been awarded the George Frederick Kunz Prize for 1941 of the New York Academy of Sciences for his paper on the "Development of the Northern Allegheny Synclinorium and Adjoining Regions." Dr. Otto H. Haas, research associate in paleontology at the American Museum of Natural History, will receive one of the A. Cressy Morrison prizes of $200 for his paper, "The Vernay Collection of Cretaceous (Albian) Ammonites from Angola."

THE Atwood award of $500 for research in physical geography was granted to Dr. George B. Cressey, chairman of the department of geology and geography at Syracuse University, at the annual meeting of the Association of American Geographers in New York City. Dr. Cressey's project calls for a study of land forms in New York State, and is the outgrowth of a National Research Council Committee working on larger aspects of the problem.

The News Edition of the American Chemical Society states that Dr. Fritz Hofmann, director of the Silesian Institute for Coal Research, has received the Goethe Medal for Arts and Sciences in recognition of research relating to production of synthetic rubber.

DR. GARY N. CALKINS, professor emeritus of protozoology at Columbia University, was recently honored by his former graduate students. A representative group, headed by Professor L. L. Woodruff, of Yale University, made a surprise visit to his Scarsdale home to present gifts and greetings. One of the gifts was a handsomely bound volume of letters containing expressions of high regard and affection from students, associates and numerous friends.

DR. CHARLES P. OLIVIER, professor of astronomy at the University of Pennsylvania and director of the Flower Observatory, succeeds Dr. George Rosengarten as president of the Rittenhouse Astronomical Society. The address as retiring president of Dr. Rosengarten was entitled "Galileo, Scientist and Man," commemorating the three-hundredth anniversary of Galileo's death.

DR. FRANCIS O. SCHMITT, professor of biology at the Massachusetts Institute of Technology, has been appointed head of the department of biology and biological engineering. The courses in public health, hitherto given in this department, will be continued under the administration of a separate department in charge of Dr. Clair E. Turner, professor of biology and public health. Dr. Schmitt, whose appointment becomes effective next July, will succeed Dr. Samuel C. Prescott, who will retire next June.

AT the School of Biological Sciences of the University of Tennessee, Dr. Kendall B. Corbin, head of the department of microscopic anatomy, succeeds the late Dr. August H. Wittenborg as chief of the division of anatomy. Dr. Corbin continues as professor of microscopic anatomy. Dr. Arthur P. Richardson, assistant professor of pharmacology at Stanford University, has been appointed associate professor of pharmacology and head of the department of pharmacology. Dr. Samuel B. Barker, research fellow in medicine at Cornell University Medical College, has been appointed instructor in the department of physiology.

C. BERTRAND SCHULTZ, since 1927 a member of the Nebraska State Museum, University of Nebraska, and since 1938 assistant director, has been appointed director, succeeding Erwin H. Barbour.

DR. JOHN E. ANDERSON, director of the child welfare institute, University of Minnesota, has been appointed chairman of the Minnesota committee of the White House Conference on Children in a Democracy.

Museum News reports that J. Eric Thompson, of the staff of the Carnegie Institution of Washington, has been given an honorary appointment as research associate in Middle American archeology by the Field Museum of Natural History.

THE Society for Research on Meteorites has appointed Henry W. Nichols, chief curator of geology of the Field Museum, Chicago, as a member of the Committee on Legal Ownership of Meteorites and of the Committee on Terminology.

DR. MAX LEVINE, professor of bacteriology in Iowa State College and major in the Sanitary Corps, has been called to service with the second medical laboratory of the third army, at Fort Sam Houston, Texas.

DR. ANTOINE M. GAUDIN, Richards professor of mineral dressing at the Massachusetts Institute of Technology; Dr. William H. Hobbs, professor emeritus in the department of geology, University of Michigan, and Dr. Francis A. Thomson, president of the Montana School of Mines, Butte, have been appointed delegates from the Carnegie Endowment for International Peace to the first Pan American Congress of Mining Engineering and Geology, which meets at Santiago, Chile, from January 15 to 24. Dr. Hobbs is the only one of the delegates who is in attendance. The congress was organized by the Institute of Mining Engineers of Chile under official auspices by decree of the government of Chile, and the South American Union of Engineers.

PROFESSOR D. L. HOLL, of the department of mathematics of Iowa State College, gave a series of lectures at Brown University from January 6 to 8 on the energy theory of thin plates.

DEAN GEORGE F. KAY, formerly head of the department of geology of the State University of Iowa and Iowa state geologist, will deliver the Bownocker lectures of the Ohio State University on January 21 and 22. Dean Kay will give two lectures in the department of geology and one before Sigma Xi. The titles are: Ancient dust storms—the loesses, Duration of the glacial period and the Glacial period in Iowa.

DR. FRANK H. JOHNSON, professor of microbiology at Princeton University, gave on January 6 a lecture on "A Common Mechanism in the Biological Effects of Temperature, Pressure and Narcosis" before the Sigma Xi Club of North Carolina State College. For the work described in this paper, Dr. Johnson and his associates received the $1,000 award of the American Association for the Advancement of Science.

THE thirteenth spring meeting of the American Society for Testing Materials and the society's committee week will be held in Cleveland, from March 2 to 6, inclusive, with all sessions at the Hotel Cleveland.

THE annual meeting of the Federation of American Societies for Experimental Biology will be held at Boston from April 1 to 6. At the Chicago meetings, the proposal to publish a Federation Proceedings was ratified and its quarterly publication will commence in 1942. The March issue (1942) will contain the abstracts of papers for all societies and will replace the usual preprints. Two subsequent issues will be devoted to joint session and symposium papers, and the December issue will replace the present yearbook. The Control Committee consists of W. O. Fenn, *chair-*

man, Philip Bard, C. G. King, Morton McCutcheon, C. F. Schmidt, A. H. Smith and D. R. Hooker, managing editor.

THE *British Association of Scientific Workers* held a conference in London on January 10 and 11 on "Science and the War Effort." There were sessions on food and agriculture, building, housing and air raid protection, training of technical personnel, science in the services and industrial production. Dennis P. Riley, foreign relations officer, reports that there will be a broadcast to the United States by some of the participants in the conference on Saturday, January 17. He also states that "Science and the World Order," a Penguin volume, will be issued shortly. The book is an outgrowth of the deliberations and discussions of the British Association conference of September, 1941.

A SYMPOSIUM on Viscosity, Molecular Size and Molecular Shape will be held on February 20 under the sponsorship of the American Society of Rheology at the Polytechnic Institute of Brooklyn. M. L. Huggins, of the Eastman Kodak research department, will make an address on "Theoretical Fundaments Concerning the Connection between Viscosity, Molecular Size and Molecular Shape." This will be followed by a discussion. In the afternoon Dr. M. A. Lauffer, of the Rockefeller Institute for Medical Research, Princeton, N. J., will speak on "Experimental Methods and Facts."

THE formal celebration of the fiftieth anniversary of Drexel Institute of Technology, Philadelphia, planned for the spring of 1942, has been postponed. It has been decided to cancel further plans owing to the present war crisis.

A NEW laboratory to be used for pathology and research in ophthalmology has been opened at the University of California. Dr. Michael J. Hogan, of San Francisco, has been made director of the new unit. The laboratory was made possible by a fund of $70,000, known as the Charles Taylor Reeves Foundation, the income from which is to be used in the study of diseases of the eye. The building was made possible by a gift from Mrs. E. S. Heller.

DR. ALLEN T. NEWMAN, dean of the New York University College of Dentistry, has announced that because of the pressing need for specialists in dental reconstruction and rehabilitation, the College of Dentistry of New York University has established a comprehensive graduate program for the training of clinical and research workers.

A CARD index of x-ray diffraction data for use in the Hanawalt Method of Chemical Analysis by X-ray Diffraction has been published by the American Society for Testing Materials. The data include not only Hanawalt's original published data, with his later corrections, but also additional data that have been contributed by Hanawalt, by the Aluminum Company of America and the New Jersey Zinc Company, together with data taken from the technical literature of the English language. It has been assembled by a joint committee of the National Research Council and the American Society for Testing Materials, the personnel of which is made up of members of the Committee on X-ray and Electron Diffraction of the Division of Chemistry and Chemical Technology of the National Research Council and representatives from the Committee on Chemical Analysis of Metals and the Subcommittees on Metallography and Radiographic Testing.

BEGINNING with Volume 3, 1942, the name of the "Bibliography of Pharmacology" will be changed to the "Bibliography of Pharmacology and Chemotherapy." No change in scope is contemplated; "chemotherapy" is added only to make the title more accurately descriptive. The field of the bibliography is defined as: "A reference list of current American and foreign literature relating to the action of known chemical compounds (natural or synthetic) on animal organisms and to therapeutic use of such compounds, including clinical investigations but not including routine clinical and case reports." Requests for more information or for a specimen page may be addressed to the Hooker Scientific Library, Central College, Fayette, Mo.

Nature states that, according to the annual report for 1939 of the Public Health Commission in India, the outstanding feature in that year was the large decrease in the incidence of cholera. Whereas in 1938 deaths from the disease in the Punjab numbered 5,670, in 1939 they were only 19. Improved sanitation of the villages and towns through which pilgrims pass is the most effective method of prevention, but is a slow process, and in the meantime the best practical method is anti-cholera inoculation, its compulsory enforcement being the best practical measure. Of the annual six million deaths in India a fifth or a quarter is attributed to malaria, to outbreaks of which India is everywhere subject, except in areas 5,000 feet above sea-level and a few widely separated regions. In the large cities such as Bombay and Delhi control measures are being successfully carried out, but rural malaria is a difficult problem. The general policy of provincial authorities is to provide an adequate supply of quinine or cinchona febrifuge to popularize the use of these drugs and to provide for their distribution by traveling dispensaries. The greatest source of danger from yellow fever lies in the air-traffic passing through infected areas in Africa. Under government rules any person who has been in a yellow fever area is forbidden to enter British India until nine days after exposure, unless he has been inoculated or is protected by a previous attack.

THE U. S. Civil Service Commission has announced examinations for "Junior Professional Assistant and Student Aid" designed to recruit college graduates and junior and senior students for positions in the government service. Optional branches include (all in the junior grade at $2,000 a year): agricultural economist, agronomist, aquatic biologist, archivist, bacteriologist, biologist, chemist, entomologist, forester, geologist, junior in household equipment, olericulturist, pomologist, public welfare assistant, range conservationist, soil scientist, State Department assistant and statistician. A four-year college course leading to a bachelor's degree is required, with major graduate or undergraduate study in the field of the optional subject. Senior or graduate students may be admitted to the examination, and may, upon attaining eligibility, receive provisional appointment, but can not enter on duty until evidence of the successful completion of the required college course is furnished. Applicants must not have passed their thirty-fifth birthday. Student aid positions pay $1,440 a year. Usually employment is during the school vacation periods; when furloughed, appointees may return to their college studies. Applicants for these positions must not have passed their thirteith birthday. Applications for both these examinations must be on file with the Washington office not later than February 3.

DISCUSSION

CONTINENTAL DRIFT AND PLANT DISTRIBUTION

NORTH AMERICA and Eurasia, which comprise the major part of the earth's land surface, lie entirely within the Northern Hemisphere, and it is evident that the two continents have always been more or less intimately connected. This is shown especially in the marked similarity of the vegetation, particularly in the higher latitudes.

There are many identical or closely related species throughout the Arctic and subarctic zones, including species of pines, spruces, firs and some other conifers, as well as some deciduous trees, and shrubs like the birches and willows. Further south, in the more temperate latitudes, such common deciduous trees as oaks, chestnuts, beech, maples, elms and others are much the same, in North America and Eurasia.

The greater part of North America is north of the Tropic of Capricorn and extends beyond the Arctic Circle. Practically the whole of the United States is within the "temperate" zone. Except for the Pacific Coast and the Gulf States the climate is a pronounced continental one, with wide range of temperature between summer and winter; and for the most part, winter is a season of almost complete cessation of active vegetation.

The southern continents, South America, Africa and Australia, are separated by the great oceans, nevertheless they have much in common in their vegetation, indicating some former land connections.

The major parts of South America and Africa lie within the Tropics. The southernmost point of South America, Cape Horn, is less than 60° S. There is nothing corresponding to the Arctic and subarctic floras of the Northern Hemisphere, and the land areas of the South Temperate zone are relatively limited in extent. The climate is more of an insular than continental type, and there is no such difference between summer and winter temperatures, as occurs in corresponding northern latitudes.

A comparison of the north and south temperate floras of the Western Hemisphere shows they have little in common except some cosmopolitan genera. The conifers and most of the dominant deciduous trees and shrubs of North America are absent from South America. The conifers of South America are austral genera, absent from North America, *e.g.*, Araucaria, Podocarpus, Fitzroya, and others, while there are many evergreen Angiosperms, *e.g.*, Myrtaceae, Proteaceae, unknown in temperate North America.

While there is thus little connection between the temperate floras of North and South America, there are many common genera and even species in Chile and New Zealand—separated by the whole Pacific Ocean; and the tropical floras of equatorial Africa and South America have also many common genera and even species. An exception to the rule of the absence of North American temperate species in South America is seen in a considerable number of common species in Central Chile and California. This is presumably a case of migration along the continuous mountain range extending along the Pacific Coast from Chile to Alaska.

FOSSIL EVIDENCE

The many investigations of the fossil floras of North

America indicate that the Tertiary genera and some species were much like those of the present; but the geographical distribution has in many cases shifted. Most remarkable is the occurrence in Greenland and Alaska, actually well within the Polar Circle, of fossils belonging to genera now found in warm temperate or even sub-tropical regions.

It is difficult to imagine any possible conditions of climate in which these plants could grow so near the Pole, deprived of sunlight for many months of the year. The occurrence of so many related species in the at present widely sundered southern continents can be explained only on the assumption of some former land connections. The theory of Continental drift has been proposed by several writers, notably the recent volume[1] of Dr. A. S. du Toit. du Toit is influenced by the work of Wegener, but differs from Wegener in assuming two primordial continents, a northern one, Laurasia, and a southern one, Gondwana, instead of Wegener's "Pangaea." From Gondwana were separated the four present southern continents, which finally drifted to their present locations. This theory would best explain most of the problems in the geographical distribution of the floras of the Southern Hemisphere.

DOUGLAS H. CAMPBELL

STANFORD UNIVERSITY

SCLEROTIUM BATATICOLA, A CAUSE OF DAMPING-OFF IN SEEDLING CONIFERS

Sclerotium bataticola Taub. was isolated from young Norway spruce seedlings by Dr. L. W. R. Jackson, pathologist at the Allegheny Forest Experiment Station, in 1935. He later turned over cultures of this fungus to the writer, who has found that it attacks the germinating seeds and early seedlings of Douglas fir (*Pseudotsuga taxifolia* Brit.), Norway spruce (*Picea Abies* (L.) Karst.), American larch (*Larix laracina* (DuRoi) Koch), and the following species of pine-jack (*Pinus Banksiana* Lamb.), red (*P. resinosa* L.), Scotch (*P. sylvestris* L.) and Western yellow (*P. ponderosa* Dougl.). The inoculation experiments were conducted in the laboratory and greenhouses at the Morris Arboretum of the University of Pennsylvania. Pre-emergence and post-emergence damping-off occurred in all species mentioned. *Sclerotium bataticola* was reisolated from all stages of damped-off seedlings.

Under the conditions of these preliminary experiments, the pathogenicity of *Sclerotium bataticola* was thus confirmed for the species of conifers mentioned.

SPENCER H. DAVIS, JR.

UNIVERSITY OF PENNSYLVANIA

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[1] "Our Wandering Continents." London, 1937.

PHYSICS IN NAZI GERMANY

IN SCIENCE for November 1, there was published a letter from an unidentified correspondent in Russia, which seems to imply that the Nazi authorities in Germany condemn "theoretical physics" as "Jewish physics" because of its Jewish origin. Is it not far more likely that the present masters of Germany discredit those particular branches of theoretical physics which are commonly known as quantum theory and relativity because they do not find them useful, and call them Jewish to disparage the Jews?

We in America hate tyranny—whether it be tyranny of men or tyranny of ideas. We should accord abtruse theories respectful consideration if they are both honest and able attempts to account for observations not previously fully accounted for, but we should not permit them to tyrannize. Your correspondent, however, disparages Stork because "it is obvious that the author tries to refute the modern theory of quantum mechanics." Since when has this become an offense? Quantum theory has not been deified in America, and undoubtedly there are still "thirty thousand men in Israel" who have not bowed down before it. Endeavors to confirm the quantum theory are still made in abundance. Should the few who seek unification of science along other lines be disparaged as necessarily anti-Jewish?

The true status of these two branches of modern physics, so far as the general public is concerned, is about as follows: Even Mr. Einstein has not yet been able to reconcile relativity and quantum theory, though he has made the endeavor to do so almost a life work. There has been no derivation of the electromagnetic theory from the principles of quantum mechanics, although a reconciliation between the two was promised and has been hoped for. Even Bohr now says that quantum principles do not apply in nuclear physics.

Relativity has not been applied to any attempt to control phenomena. Quantum terminology has been adopted in spectroscopy, and is used in all spectral classification work, there being as yet no other. The "numerous remarkable discoveries" attributed to quantum theory are at least chiefly due to classification schemes, and not necessarily to the idea of monochromatic unidirectional radiation quanta produced by losses of energy by moving electrons. The electromagnetic theory, however, has been vastly extended in its usefulness.

There seems to be a need for search for modes of interpreting phenomena that are not bound *a priori* to any postulates that seem irreconcilable to what is too often referred to disparagingly as "classical theories."

Nazis may couple men and ideas for the purpose of disparaging both. We should avoid any such confusion, either to disparage or to exalt a theory.

WM. MAYO VENABLE

PITTSBURGH, PA.

A SCIENTIST AT PEACE AND AT WAR FOUR HUNDRED YEARS AGO

THE manner in which one great scientist of the past, Nicolò Tartaglia of Brescia (*c.* 1500–1577), conducted his conscience in the face of the differing requirements of peace and war, may not be without some interest to scientists of the present day who find themselves in a similar situation.

In the "Epistola" to his "Della Nuova Scienza," written at Venice 20 December 1537 (O.S.), and addressed to his Excellency the Duke of Urbino, Tartaglia writes:

> When I was living in the town of Verona, Illustrious Duke, one of my intimates, my cordial friend the master of ordnance at the old castle, (a man of experience and great skill in his art, and endowed with an abundance of good qualities), asked me one day my opinion how to aim a piece of artillery to give it the greatest range. Although I had no practical knowledge whatever of artillery, for in truth, Excellent Duke, I have never in my life shot a single round with firearms, arquebus, bombard or musket, nevertheless, being desirous of serving my friend, I promised shortly to give him a definite answer to his question.[1]

Tartaglia then proceeds to give an account of his attack upon the problem set him by his friend, and then goes on to remark:

> As the result of this I had the intention of writing a treatise on the art of artillery, and to bring it to a degree of perfection capable of directing fire in all circumstances, assisted only by a few particular experiments: for as Aristotle says in the seventh book of the "Physica," Section 20, "particular experiments are the basis of universal science."
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> But, since then, one day meditating to myself, it had seemed to me that it was a thing blameworthy, shameful and barbarous, worthy of severe punishment before God and man, to wish to bring to perfection an art damageable to one's neighbour and destructive to the human race, and especially Christian men in the wars that they wage on one another. Consequently, not only did I altogether neglect the study of this matter and turned to others, but I even tore up and burnt everything which I had calculated and written on the subject, ashamed and full of remorse for the time I had spent on it, and well decided never to communicate in writing that which against my will had remained in my memory, either to please a friend or in teaching of these matters which are a grave sin and shipwreck to the soul.[2]

In view, however, of the preparations of the Turks to invade Italy, who, as Professor J. D. Bernal has pointed out,[3] were instigated by his Most Christian Majesty the King of France,[4] Tartaglia suffered a change of mind. He writes:

> To-day, however, in the sight of the ferocious wolf preparing to set on our flock, and of our pastors united for the common defence, it does not seem to me any longer proper to hold these things hid, and I have resolved to publish them partly in writing, and partly by word of mouth, for the benefit of Christians so that all should be in a better state either to attack the common enemy or to defend themselves against him. I regret very much at the moment having given up this work, for I am certain that had I persevered I would have found things of the greatest value, as I hope yet to find. . . . I hope that your Lordships will not disdain to receive this work of mine so as better to instruct the artillerymen of your most illustrious government in the theory of their art, and to render them more apt in its practice.[5]

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SCIENTIFIC BOOKS

THE EARTH

Biography of the Earth. By GEORGE GAMOW. 242 pages; 35 plates; 58 figures. New York: Viking Press. 1941. $3.00.

THE barriers between the sciences are now quite generally down, and no geologist will think that even a professor of theoretical physics is poaching on forbidden territory when he writes such a book as this. On the contrary, geologists will thank Dr. Gamow for making the history of the earth so interesting to the layman by his lucid, fluent style, his enthusiasm for the subject, and his wise selection of items to be stressed. Certainly, the truly fascinating story of the origin, infancy and adolescence of an earth, still far from decrepit old age, has seldom been told with such verve and ingenuity of phrase, combined with essential accuracy and fidelity to technical lore, as that which characterize this book.

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[1] "Della Nuova Scienza," in "Questi et Invenzioni Diverse de Nicolo Tartaglia, Di nouo restampati con vna Gionta al sesto libro, nella quale si mostra duoi modi & continentia di tutta l'opera nel seguente foglio si trouara notata." [Venezia, 1550], (p. 1). I have not been able to see an earlier edition of this work, and so translate from the only edition available to me.

[2] *Ibid.*, p. 6.

[3] J. D. Bernal, "The Social Function of Science," p. 169. New York: The Macmillan Co., 1939. The second and third parts of the translations here given from Tartaglia are from the version in Bernal's excellent work. The passages are incorrectly attributed by him, on the basis apparently of a French translation, to a section entitled "L'Art de jecter les bombes."

[4] The modern parallel is, of course, Hitler playing Mephistopheles to Japan's Faust.

[5] Tartaglia, *loc. cit.*, p. 6.

After all, geology is in the nature of the case an application of the principles of physics, chemistry and biology to the study of the earth and its inhabitants. Whereas, analysis—the learning of more and more about less and less—is essential to the discovery of knowledge, it is equally true that synthesis—the assembling of the jigsaw puzzle into a unified and comprehensive picture—is essential to the dissemination of knowledge. Many scientists, fortunately, are now accepting responsibility for the second as well as the first of these two tasks. None is fulfilling that duty more satisfactorily than Dr. Gamow. The book now in hand, together with its predecessor, "The Birth and Death of the Sun," will give the general reader an accurate perception of the vast sweep of cosmic history and a true perspective of man's place in the universal scheme of things.

There are of course a few details of geologic fact and theory, as set forth by Dr. Gamow, that could be questioned, but with one exception these are minor matters and detract little from the general merit of his work. One serious flaw ought to be called to his attention. It involves the great unsolved geological problem for the solution of which the assistance of the physicist is essential. Dr. Gamow ascribes mountain-making to earth shrinkage, although he correctly computes as extremely small the amount of such shrinkage that could be attributed to decrease in internal temperature during the last few hundred million years. This, he asserts, is nevertheless adequate to explain the height of mountain systems above adjacent lowlands or sea floors. That is doubtless true, but the problem of mountain-making processes is a vexing one, not because of the height of mountains but because so many of them are composed of tangentially compressed and overthrust rocks that indicate scores of miles of circumferential shortening of the earth's crust. Radial shrinkage as a result of decrease in the earth's body temperature is woefully inadequate to cause the observed amount of horizontal compression. Therein lies the real perplexity of the problem of mountain-making. Geologists have not yet found a satisfactory escape from this dilemma; perhaps Dr. Gamow will pursue the subject farther.

KIRTLEY F. MATHER

HARVARD UNIVERSITY

BANCKES'S HERBAL

An herbal [*1525*]. Edited by SANFORD V. LARKEY and THOMAS PYLES. New York: New York Botanical Garden. 1941. $3.50.

THE early literature of plants was closely associated with that of drugs. Most of the prescriptions, although fearfully and wonderfully compounded, were based primarily upon plants or their derivatives. The student of plants was almost always a physician, and unless he knew of some supposed virtue in a plant or could discover (or imagine) one on his own account, that plant was beneath his notice.

Various compilations relating to plants and their medicinal uses existed in manuscript form long before the invention of printing, and it is not at all strange that the practitioners of the new art should seek to embalm the accumulated wisdom of these manuscripts in the printed page. The resulting volumes, called "herbals," were very popular, and often went through various editions. But they were usually printed in Latin, and it was not until many years had passed that one appeared in English.

At last two English herbals made their appearance, and were so popular that they were both reissued repeatedly, with slight changes, within fifty years. One was a folio called the "Grete herball," the other a small volume, of which the earliest known edition is now reprinted. Both were anonymous compilations; the present one, dated March 25th, 1525 (the first day of the year, according to the calendar then in use), is known as "Banckes's Herbal," from the name of the printer, Richard Banckes.

It came to the notice of the management of the New York Botanical Garden that the "Scholars' Facsimiles and Reprints" of New York were planning to issue this reprint, and arrangements were made by which it has appeared as a publication of the Garden. The editing and transcription into modern English are by Dr. Sanford Vincent Larkey, of the Johns Hopkins University, and Professor Thomas Pyles, of the University of Maryland, who also prepared the scholarly introduction. The original black-letter book, of 72 unnumbered pages, is reproduced in facsimile, and this is followed by a much more readable transcription, with numerous corrections of spelling, punctuation and capitalization, and the occasional substitution of a word that will make the author's intent more intelligible to a modern reader. The corrections, however, have been made sparingly and judiciously, so as not to interfere with the quaintness of the original text.

The facsimile reproduction is from a copy in the library of the British Museum; the only other known copy is in the Henry E. Huntington Library in California. The New York Botanical Garden is to be congratulated upon placing this little classic, so well printed and edited, in the hands of the medical, botanical and horticultural public.

The statement in the introduction that this "was the first book devoted exclusively to herbs to be printed in England" is certainly open to question, unless modified by the words "of which a copy is now known to exist." It is true that the earliest copies of the "Grete herball" now known are dated July 26, 1526, but this was certainly not the first edition, and good evidence exists that in its first form it was dated June 20, 1516—nearly nine years earlier than Banckes's Herbal.

JOHN HENDLEY BARNHART

REPORTS

SCIENTIFIC WORK OF THE CARNEGIE INSTITUTION OF WASHINGTON[1]

A REVIEW of all the activities of the institution would make interesting reading, but it will have to wait until the time comes when the full story can be told. It is now impossible to mention fine work being done by many of the staff members of the institution, since it remains in a confidential category.

The normal research activities of the staff, in view of the interruptions and distractions now present, are not inconsiderable. The full Year Book gives the record, again with an interpretive statement by each director of a department or division. Here a few high lights will be noted, in the hope that this will lead to further perusal.

In spite of preoccupation of most of the staff members of the Department of Terrestrial Magnetism with defense research, the fundamental program of this department still continues significantly. Unless further delays accrue in procuring materials for which priorities are sought, the cyclotron will shortly be completed and made available for cooperative studies in which the Department of Embryology and the Department of Genetics will have a part. Searchlight studies of the electrical and chemical conditions of the air at great heights are also progressing, as well as coordination of magnetic, solar and upper-air studies as related particularly to problems of radio transmission.

Dr. Adams reports from Mount Wilson a number of interesting results. To seize upon one of these, he tells of the first definite evidence of the presence of iron in interstellar space, the density being such that there is present roughly one atom in a cubic meter. This is a very low density. The best vacuum man has produced artificially still contains gas many million times as dense. Yet interstellar space is so enormous that the mass of material represented in these gases is large, and the significance of the discovery may be great. Continued study of atomic and molecular spectral lines from this vast area may in time give us not only the composition but also the distribution and motions of the clouds of cosmic dust and gas that inhabit it, and provide much knowledge of the physical state of its matter. Another item relates to the discovery of the remains of Kepler's Nova of 1604 through the use of red-sensitive plates, and its recognition as the third supernova to appear in the observable region of the galactic system within the last 900 years. Finally, the vexed question of the direction of rotation of the great universes of stars represented by the spiral nebulae seems to have received a definite answer. The evidence shows clearly that in each of the objects investigated the spiral arms are trailing as the nebula rotates. This result is of fundamental importance in theories of the origin and dynamics of stellar systems.

Completion of construction of the 200-inch telescope at California Institute of Technology has been somewhat retarded by pressure of defense research activities, but we continue to cooperate closely in this program, and in consideration of plans for future operation of the giant telescope. In accordance with agreement reached in 1936, tapering financial support which the institution has provided for the seismological program at California Institute will terminate this year.

The Geophysical Laboratory has been concerned with investigation of the radioactive content of rocks as a vital factor in many geophysical problems, and as a part of this undertaking determination of radioactive elements in deep-sea cores obtained by Piggot from the Caribbean Sea has developed new and fundamental relationships. In this connection also a special study of radioactive elements in sea water has been carried out during the past year. Ultrabasic, deep-seated rocks make up the fundamental material of the earth's structure, and the whole problem of the thermal conditions of the earth depends largely on the radioactive content of certain of these rocks. It has now been possible to initiate a cooperative study concerning determination of age and heat production relating to rock formation. The equipment for studying silicate minerals in the presence of water at high temperatures and pressures such as prevail deep within the earth has produced a variety of interesting results. This apparatus is essentially an electric furnace within a strong closed chamber in which materials can be exposed to the action of steam at pressures of several thousand pounds and at temperatures far above a red heat. In the course of some experiments on solubility and melting point the formation of clear quartz crystals at a fairly rapid rate was observed.

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[1] From the annual report of Dr. Vannevar Bush, president of the Carnegie Institution of Washington.

Other arrangements of the apparatus caused an unusual deposit of minerals formed by a solution of material in the vapor phase, followed by deposition in another part of the furnace. One of these minerals was sillimanite, which formed long needles of good size. This is the first time that this mineral has been obtained artificially, and it is probable that the manner of its formation in nature is similar in some respects to that here observed.

Further progress in studies on photosynthesis is reported from the Division of Plant Biology. Recent research relating to the chemical mechanism of the photosynthetic process has necessitated a considerable revision of the older set of hypotheses in regard to the chemical interactions involved. Refinement of existing methods of chemical analysis of the precise nature of the product formed by photosynthesis is being undertaken, and new materials are being subjected to photosynthetic measurements, including certain diatoms under culture. All lines of evidence, morphological, ecological, genetical and cytological, are brought to bear on problems concerning the analysis of plant relationships, in studies in the field of experimental taxonomy. These various methods of procedure are serving as effective checks and balances in development of the species concept.

As a result of work at the Department of Genetics, Blakeslee and his associates, by further application of the alkaloid colchicine method in study of the developmental history of the plant, have found that the stamen is evolutionarily a reduced axis and not homologous with a leaf, as is the classic belief. A gene mutant type has been located in *Datura* which so closely resembles the peculiar effects of a certain virus disease that further light is thrown on the question whether there are not close similarities between genes and virus particles, the chief difference between the two, perhaps, being in the fact that the virus particle has unlimited powers of multiplication, whereas the gene is imprisoned within a chromosome and can multiply only when the latter divides.

In accordance with the expressed desire of the trustees of the institution for the development of an effective program for cooperation between the Department of Genetics and the Long Island Biological Association at Cold Spring Harbor, an agreement was reached whereby Dr. Demerec, assistant director of the Department of Genetics, served as director of the Biological Laboratory of the Association during the summer of 1941, and Dr. Corner served as chairman of a scientific advisory committee for the Biological Laboratory program. This arrangement led to a symposium at Cold Spring Harbor on the subject of the gene and chromosome, which attracted a large group of scientists, and which was followed by the annual meeting of the Genetics Society of America. Plans for continuation of such effective cooperation are being formulated in connection with the institution's program of research at Cold Spring Harbor for next year.

The program of the Department of Embryology contemplates an increased use of physiological, physical and chemical methods in expansion of the experimental studies of mammalian embryology. Whatever work is undertaken in the future, however, will be intimately and soundly based upon the understanding of the form and structure of the human embryo which has so remarkably and effectively grown out of the past activities of this department. Dr. Streeter is now engaged in classifying and summarizing the results of these morphological studies on the development of the early human embryo, in fulfillment of one of the original purposes for which the Department of Embryology was established. The full statement of the objectives of the department is presented by the new director, Dr. Corner, after a year of study and consultation with his colleagues, during which time the aims of the program of research have become focused, although so defined as to admit of adaptation as conditions and opportunity may warrant.

Despite cooperation in defense research, which has required attention of staff members of the Nutrition Laboratory, work at the laboratory has progressed in development of instrumental technique and in cooperative studies of carbohydrate metabolism with reference to diabetes.

Dr. Kidder reports the interesting circumstances surrounding the discovery of ancient footprints in a stratified formation in Nicaragua, which was previously reported to the trustees. Investigation is being extended in the attempt to learn, if possible, more about the individuals who made these tracks, and when they made them. Work has proceeded at the ruins of Copan, Honduras, where extensive and necessary repairs are being completed preparatory to the inauguration of a brief but intensive program of archeological study. Continuation of humanistic studies in Middle America has placed the institution in an unusually favorable situation to cooperate effectively in various types of scholarly effort being undertaken in this region by numerous agencies.

Fortunately the institution has been privileged, even under somewhat adverse conditions, to continue its cooperation with a number of other agencies in furthering fundamental studies having direct relation to its major projects. Comments by directors on such subjects will be found in the Year Book, as well as independent reports from some of the investigators who have worked upon cooperative problems during the past year.

SPECIAL ARTICLES

THE ENDOSPERM AS A BARRIER TO INTERSPECIFIC HYBRIDIZATION IN FLOWERING PLANTS[1]

FOLLOWING fertilization between species, development of the seed is frequently arrested short of a condition which permits germination. The line of descent embodied in the hybrid embryo is thus summarily terminated. The question whether collapse is due to defects in the embryo itself or to abnormal behavior of the accessory tissues of the seed is of considerable theoretical and practical interest.

Genetically speaking, the angiosperm seed is a chimera, comprising embryo, endosperm and maternal tissues differing from each other in hereditary organization. The embryo develops from the fertilized egg. The endosperm, which is the product of an independent fertilization, is normally triploid, its primary nucleus receiving two sets of chromosomes from the macrogametophyte. These two structures are enclosed in maternal tissue usually consisting initially of a nucellus and either one or two integuments. Several investigators have considered that a disturbed developmental relationship between these genetically diverse components is responsible for failure in hybrid seeds. The evidence brought forward, however, has not been clear regarding the tissues involved or the character and sequence of events leading to collapse. Formulation of a satisfactory working hypothesis concerning the cause of failure, therefore, was not possible.

Recent investigations in this laboratory indicate that the primary cause of hybrid seed collapse is weak growth of the endosperm. The effect, however, is indirect. The subnormal development, which may be detected soon after fertilization, induces modifications in the associated maternal tissues, which in turn react unfavorably upon the endosperm. The latter becomes starved, the cells break down and the seed collapses.

The embryo, although often retarded, may continue to grow while these changes are in progress. Critical evidence to exclude it is lacking, but there are no positive indications that the embryo itself is a factor contributing to failure. It is still very small, sometimes only just beyond the zygote stage, when the transformations occur in the young seed which appear to determine largely the future course of development. On the other hand, the endosperm at this time is regularly more advanced, which strongly suggests that it, rather than the embryo, is the controlling tissue. Later, of course, the embryo may become the dominant structure of the seed, but failure of the type under consideration, even though it may be delayed, rather clearly has its origin in early post-fertilization behavior.

Since the discovery of double fertilization at the close of the last century and the interpretation of xenia in maize in the light of it, it has been apparent that the endosperm possesses some measure of genetic autonomy. The evidence from xenia, however, relates to the mature endosperm in one of the relatively few families of angiosperms in which the tissue characteristically persists. It casts no light on the extent to which early endosperm behavior is genetically controlled in the far larger proportion of species in which the tissue is present in the young seed, but later disappears. Furthermore, embryological studies have rather consistently underestimated the importance of the endosperm as a factor in early seed development.

Three facts are now established which appear important for an understanding of the type of seed failure in question. (1) In addition to the trophic properties commonly attributed to it, the endosperm plays a basic rôle in the morphogenetic changes involved in transformation of the ovule into a seed.[2] This is clearly shown in *Nicotiana rustica.* Following normal self-fertilization the funicular cells between the apex of the vascular bundle and the chalazal pocket become differentiated into conducting cells. The histological evidence strongly suggests that this important step is a response of the contiguous maternal tissue to the endosperm which is developing very rapidly at the time. The differentiation does not occur if *N. rustica* ovules are fertilized by *N. glutinosa* or *N. tabacum.* (2) Behavior of the endosperm during early post-fertilization stages is significantly influenced by the genetic make-up of the tissue. This fact was established quantitatively in *Medicago sativa,* in which a significant difference in rate of free nuclear division was observed in inbred and crossbred endosperms.[3] It was confirmed in *Nicotiana rustica,* in which the normal endosperm develops much more rapidly than do *N. rustica* × *N. glutinosa* and *N. rustica* × *N. tabacum* endosperms.[4] (3) In seeds which fail, the collapse follows changes in the maternal tissues which arise as a result of hypofunction of the endosperm. Associated with the weakly growing endosperms in self-fertilized *Medicago sativa*[3] and in the above-mentioned Nicotiana interspecific hybrids[4] there is overgrowth of the adjacent maternal tissues which eventually induces signs of starvation in the endosperm itself and precipitates collapse of the seed. It was found that in *N. rustica* × *N. tabacum* seeds in which collapse is delayed so that a germinable condition may be reached, even though very rarely, the endosperm-nucellus volume ratio at early post-fertilization is higher than in *N. rustica* × *N. glutinosa* seeds, which all fail early.[4] Since the pistillate parent is the same in both crosses, it is evident that the varying degree of abnormal development of the maternal tissue in the two respective classes of seed is a function of the endosperm genotype.

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[1] Paper from the Department of Genetics, Agricultural Experiment Station, No. 293. Assistance is acknowledged from the Rockefeller Foundation and the Wisconsin Alumni Research Foundation. Aid was received also from WPA projects in the Natural Sciences No. 8549.

[2] D. C. Cooper and R. A. Brink, *Genetics,* 25: 593–617, 1940.

[3] R. A. Brink and D. C. Cooper, *Bot. Gaz.,* 102: 1–25, 1940.

[4] R. A. Brink and D. C. Cooper, *Genetics,* 26: 487–505, 1941.

The endosperm, therefore, may act as a barrier to interspecific hybridization in flowering plants. The tissue forms the basis of an isolating mechanism, to use Dobzhansky's[5] term, which tends, like numerous other physiological devices, to hinder the interchange of genes between specific groups.

It is a point of considerable practical interest that failure of the seed due to weak endosperm development does not necessarily imply that the associated embryo is inviable. The lethal mechanism is not in the line of descent but is parallel to and impinges upon a short but critical segment of it. Freed of its adverse environment in the seed before breakdown occurs, the embryo may be capable of growing into a plant. Numerous cases are on record of vegetatively vigorous interspecific hybrids having been reared from badly shrunken seeds which may have barely passed the limits of germinability in their development. If the present analysis is well founded, it is a fair inference that below this threshold there are embryos of many more hybrids the realization of whose potentialities only awaits the application of suitable technics of artificial cultivation. The work of Laibach,[6] Tukey,[7] van Overbeek *et al.*[8] demonstrates the possibilities of rearing incompletely developed embryos on synthetic media. The limits within which plant breeders may be able to explore the possibilities of interspecific hybridization now appear, therefore, to be significantly broader than earlier could have been foreseen.

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ON THE LOCALIZATION OF ENZYMES IN NERVE FIBERS[1]

CHOLINE esterase is highly concentrated at or near the neuronal surface. This was shown recently in experiments on the giant fiber of squids, where practically the whole enzyme activity was found to be in the sheath, only a negligible amount of enzyme being present in the axoplasm.[2] These observations, together with the parallelism, within certain limits, found between number of electric plates per cm, E.M.F. per cm and concentration of choline esterase in electric organs, suggest that the electrical changes observed during nerve activity may be intrinsically connected with acetylcholine metabolism.[3,4] It is necessary to know how specific is the concentration of choline esterase at the neuronal surface compared with other enzymes important for nerve activity. Studies have been started in order to determine the activity of different enzymes separately in sheath and axoplasm of the giant fiber.

Nerve activity is connected with heat production and extra oxygen uptake. Determinations of the total respiration may not yield optimal values if the cell is no longer intact. It appears safer to determine important intermediate steps. Succinic dehydrogenase is widely believed to be essential in respiratory enzyme systems. Its activity has been determined with the manometric method with ferricyanide.[5] Table 1 gives the results of an experiment showing that about 90 per cent. of the total enzyme amount is present in the axoplasm. The concentration is about 50 per cent. lower in the sheath, although the absolute amount metabolized there is so small that the values are near to the limits of sensitivity of the method. Although the greatest part of the sheath is connective tissue, the results give no indication of a higher concentration of succinic dehydrogenase at or near the surface. The contrast to the distribution of choline esterase is striking. In the whole giant fiber the concentration is intermediate between that of sheath and axoplasm, as could be expected. In the head ganglion the concentration of succinic dehydrogenase is about 10 times as high as in the fiber, whereas its concentration of

TABLE 1

SUCCINIC DEHYDROGENASE. K = CONTROL, E = WITH SUCCINATE. TIME 235 MIN. CONCENTRATION OF SUCCINATE 0.15 MOL. t = 23° C.

		Mg fresh tissue	Cmm CO_2		µg succinic acid		
			Observ.	Calc. for 100 mg	Absol.	In per cent. of total	Per 100 mg
Sheath	K	6.7	1.96	29.2			
	E	5.5	4.20	76.7	6.7	11	126
Axoplasm	K	27.5	4.5	16.3			
	E	24.9	24.6	99.0	53.5	89	216

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[5] T. Dobzhansky, *Amer. Nat.*, 71: 404–420, 1937.

[6] F. Laibach, *Jour. Heredity*, 20: 200–208, 1929.

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[1] From the Laboratory of Physiology, School of Medicine, Yale University, the Department of Zoology, Columbia University, and the Marine Biological Laboratory, Woods Hole.

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[5] J. H. Quastel and A. H. M. Wheatley, *Biochem. Jour.*, 32: 936–943, 1938.

choline esterase is several hundred times higher than in the fiber.

In one experiment with succinic oxidase the enzyme distribution between sheath and axoplasm was the same as that found for succinic dehydrogenase. The difference of enzyme concentration between fiber and head ganglion was also the same.

The formation of acetylcholine occurs only in oxygen and in presence of either glucose or pyruvic acid.[6] This suggests that the acetic acid is formed from pyruvic acid, a process which probably requires vitamin B_1. Mann and Quastel found that in the brain of vitamin B_1 deficient pigeons acetylcholine formation is accelerated in presence of potassium + vitamin B_1.[7] The greatest part of vitamin B_1 in living tissue seems to occur as diphosphothiamine (cocarboxylase). The concentration of this coenzyme has been determined in sheath and axoplasm. The method used was that of Lohmann and Schuster with slight modifications.[8] Table 2 gives an experiment showing that the concentration in the sheath is twice as high as that in the axoplasm. In view of the large fraction of connective tissue in the sheath these figures definitely indicate a concentration of diphosphothiamine in or near the surface many times as high as that in the axoplasm. The distribution differs from that of choline esterase as well as from that of succinic dehydrogenase and oxidase. It supports the assumption that one function of vitamin B_1 may be its participation in the formation of acetic acid for acetylcholine.

TABLE 2

COCARBOXYLASE. TIME 20 MIN. K = 0.05 μ COCARB.

	Mg fresh tissue	Cmm CO_2	μg cocarboxylase	
			Absol.	Per 100 mg
Sheath	14.0	2.66	0.0315	225
Axoplasm	87.0	6.89	0.0785	90
K		4.39		

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[9] Aided by a grant of the Dazian Foundation.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A COLOR REACTION FOR DEHYDROASCORBIC ACID USEFUL IN THE DETERMINATION OF VITAMIN C

WHEN the 2,4-dinitrophenylhydrazine derivative of dehydroascorbic acid is treated with 85 per cent. sulfuric acid, a reddish colored product is formed which absorbs maximally at 500–550 mu and 350–380 mu. The nature of this reaction is illustrated by the following experiment. One cc of a dilute acetic acid solution of dehydroascorbic acid is mixed with one cc of a saturated solution of 2,4-dinitrophenylhydrazine in 85 per cent. H_3PO_4. After letting stand for 5 minutes, 8 cc of concentrated H_2SO_4 is added. The same red color is obtained as that observed when the crystalline 2,4-dinitrophenylhydrazine derivative of dehydroascorbic acid is dissolved in H_2SO_4. If more time is allowed for the 2,4-dinitrophenylhydrazine to couple with the dehydroascorbic acid, a deeper red color is obtained when H_2SO_4 is added. If the three substances involved in this reaction are mixed in any other sequence, the red color is not obtained. Hence, this reaction is due to the action of H_2SO_4 on the coupled 2,4-dinitrophenylhydrazine-dehydroascorbic acid compound.

The proportionality of the color obtained in this reaction is in good agreement with Beer's law. We have used this reaction to develop a simple and rapid colorimetric method for the determination of ascorbic acid. Possible interfering substances are pentoses, glucose and fructose, which in concentrations much greater than usually found in acid extracts of plant and animal tissues will form derivatives with 2,4-dinitrophenylhydrazine. The latter dissolve in 85 per cent. sulfuric acid, giving brown to yellow colors, but they do not react with the acid except when heated or upon long standing. Furthermore, the absorption curves of the sulfuric acid solutions of the xylose, glucose and fructose derivatives of 2,4-dinitrophenylhydrazine, and also of 2,4-dinitrophenylhydrazine, show practically complete transmission in the wave-lengths at which the red color obtained from dehydroascorbic acid is compared. Hence, it appears that a completely specific principle for the determination of ascorbic acid is offered.

In the proposed method, the 2,4-dinitrophenylhydrazine derivative is isolated from unknown and standard solutions of ascorbic acid according to published directions[1] and treated with 85 per cent. sulfuric acid. Colorimetric comparison is made, using a filter with maximum transmission at 540 mu. The method will be published in detail later.

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[1] J. H. Roe and J. M. Hall, *Jour. Biol. Chem.*, 128: 329, 1939.

BINDING OF SULFONAMIDES BY PLASMA PROTEINS

Cerebrospinal fluid concentrations of sulfathiazole which occur during treatment of meningitis do not generally exceed 25 per cent. of the plasma concentrations; values for sulfanilamide in the cerebrospinal fluid may reach 100 per cent. of the plasma concentrations, whereas the values for sulfapyridine and sulfadiazine are intermediate. These differences in concentration have been ascribed to differences in the diffusibility of the drugs into the spinal fluid. An alternative explanation would be the existence of part of the drug in combination with plasma protein. Schonholzer[1] has demonstrated binding of the azo-dye of sulfanilamide, Prontosil, to serum albumin in electrophoresis experiments, but this technique does not furnish quantitative data for partial binding. The experiments reported in the present paper support the view that the sulfonamide drugs are bound to plasma proteins in varying proportions, the relative concentration of drug attained in the spinal fluid depending upon the extent to which the drug is bound in the blood.

Normal human plasma was dialyzed in Cellophane bags against 0.15 N. NaCl, buffered at pH 7.4 by the addition of 0.01 M. phosphate, with varying additions of a sulfonamide. At equilibrium the drug concentration was found to be higher in the plasma than in the buffer. While this distribution coefficient is not direct evidence of binding to protein, the data fit the Freundlich adsorption isotherm, as is the case with phenol red,[2] for which direct evidence of chemical binding has been furnished by absorption spectrophotometry.[3] Whether the phenomenon be due to adsorption, coordination, or simply depression of the activity coefficient by the protein is of less biological than chemical interest, for in any case, it is the value of the distribution coefficient which determines the distribution in the body. The binding (using the term in a very general sense) is due to albumin but not to globulin; lipid-free plasma behaves similarly. In normal plasma containing 7 per cent. protein, with drug concentrations of 10 mg per cent., the proportion of "free" (unacetylated) drug which is bound to protein is as follows:

Sulfanilamide	20 per cent.
Sulfapyridine	40 per cent.
Sulfadiazine	55 per cent.
Sulfathiazole	75 per cent.

These data can explain the observed distribution in body fluids and the greater solubility in plasma than in saline.

Preliminary bacteriostatic experiments were carried out with *B. coli* in a synthetic medium, with and without added albumin.[4] The results suggest that the concentration of unbound drug determines the level of bacteriostatic activity, the bound drug being apparently inactive. It was also noted that the order of increasing tendency to be bound to plasma albumin was identical with the order of increasing bacteriostatic effectiveness for the four sulfonamides studied.[5] This latter relationship may be of theoretical significance and is being studied further.

It has been demonstrated that the sulfonamide drugs behave as though bound in varying degree to plasma albumin or some fraction thereof, and it appears that the bound drug is not bacteriostatically effective. The effective level of the sulfonamides in the cerebrospinal fluid may therefore be as great as that in the blood stream, and the apparent level compared with the blood should not be used as a guide to the choice of a drug. Inasmuch as excellent therapeutic results have been reported with the use of sulfathiazole in meningococcic meningitis[6] it may be preferable to the more toxic sulfanilamide and sulfapyridine, which have often been favored because of the higher concentrations attained in the cerebrospinal fluid.

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LIFE IN THE ANDES AND CHRONIC MOUNTAIN SICKNESS

By Dr. CARLOS MONGE

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SINCE prehistoric times congenital or acquired acclimatization has made life possible upon the high plateaus of the Andes, where the altitude varies from 10,000 to 16,000 feet. At the present time twelve million people are living on these plateaus under normal conditions, at an oxygen pressure of about 85 mm instead of 150 mm as at sea-level. In considering the steady biological changes produced by ancestral acclimatization to chronic oxygen insufficiency we must assume that dwellers in these highlands belong to a climatophysiological variety of the human race, which, as observation shows, may even be responsible for their individual attitudes and sociological behavior. Anthropological morphology does not suffice to explain life in the Andes—the fundamental basis must be found in the physiological dynamics of altitude homeostasis. If we go back to Galen we will remember that "the organism is a whole with an environment and it can not be considered apart from that environment" (Hutchins), a fact not yet established in the natural history of men in the Andes.

The claim to acclimatization acquired after a few days or weeks, "a fallacy of misplaced concreteness," misinterprets the nature of the problem and has produced much confusion. Acclimatization connotes a balanced state of the internal milieu; therefore, at high altitudes body and mind must attain the same equilibrium that man has at sea-level. To arrive at this, to overcome the otherwise impaired condition caused by chronic oxygen insufficiency, the organism calls forth its emergency adaptative devices and builds up a new chain of biological processes to stabilize its internal environment. Thus it first has to be adapted. Adaptation is in itself a malady, slow in course, generally following an acute stage—the so-called acute mountain sickness—which may be without clinical symptoms or with only mild symptoms or with the outstanding symptomatology of chronic mountain sickness. Whether the adaptative period lasts months or years, nobody knows. Probably it depends on the ability of the individual to compensate the damage caused by the permanent effects of the lack of oxygen. This is a personal equation. There are men and animals with remarkable powers of acclimatization; there are others, on the contrary, who never achieve that goal.

When the adaptation malady is over, acclimatization supervenes: so-called chronic mountain sickness has been cured.

The Native Andean and the Adapted Man. It would obviously be pretentious to try to discuss all the biological characteristics of the Andean man, whose study is only just beginning. In both the native Andean and the adapted man you will find an increase in the number of red blood cells and in hemoglobin capacity; in size of the erythrocytes (Hurtado, Talbot); in the viscosity of the blood; in resistance to hemolysis; of hematocrit; of serum proteins (Monge-Salas); of pH, but within normal limits; in the ventilation of the lungs; and in hypertonus of the vegetative nervous system (Monge, Pesce, Aste, Salazar). There will be a decrease in arterial oxygen saturation, in carbon dioxide alveolar pressure and in alkaline reserve.

And now let us consider some of these characteristics which may differentiate the adapted from the acclimatized dweller of the highlands. Talbot emphasizes the fact that the maximum oxygen capacity of some of the adapted men of the International Expedition of 1935 never reached the lower limit of dwellers acclimatized at 5.3 km altitude. Keys, Hall and Guzmán-Barrón stated that hemoglobin has less affinity for oxygen in newcomers to the highlands than in residents, that this probably accounts for the shift to the right of the oxygen dissociation curve at high altitude, and that it may be an intermediate stage in final adaptation. In regard to the alkaline reserve, Dill, Talbot and Consolazio stated that the adapted man never reaches the lower values of the acclimatized person.

Hurtado in 1932 found an increase in the midcapacity of the lungs, a true physiological emphysema and augmented vital capacity. On the basis of animal experimentation, he believes that the dilated pulmonary capillary affords a larger contact surface for the diffusion of gases. Mori-Chavez and I, in 1934, demonstrated in guinea pigs that the hyperplasia of the capillary bed and diminished connective arteriolar structure are conditions of an acclimatized lung.

Besides the biological features, some peculiar physiological characteristics are to be observed in the Andean man. According to Rotta (1938) the cardiac index is moderately increased, the work of the heart is 20 per cent. higher, and the volume of blood is augmented. The transverse and longitudinal diameters of the heart are somewhat greater than that of the sea-level heart. The venous pressure is slightly increased. We reported in 1930–1935 that 13 per cent. of the men tested showed a heart rate of less than 50 pulsations per minute, and 41 per cent. a rate of less than 60 pulsations. But between work and heart rate there is no linear relation. After double the amount of work—1,400 kilogrammeters—the pulse is slower than for a basic work of 700 kilogrammeters. Of 300 normal and selected men, 27 per cent. showed practically no tachycardia after 700 kilogrammeters work, enduring the test without fatigue. Torres established the fact that arterial tension is lower at altitude than at sea-level. Thus there seem to be all the conditions of an athletic heart. Chronic oxygen insufficiency is a permanent stimulus to improve heart efficiency.

Clinical efficiency tests (Master test) show that half of the Andean men (300) are stronger than men at sea-level. The acclimatized man on the high plateaus climbs a mountain straight without difficulty. Adapted persons can never do that. For a moderate amount of physical work, a sea-level athlete in the highlands is in the same position as the untrained man at sea-level.

Grollman and Christensen have demonstrated that cardiac output during inactivity increases in the first few days of adaptation and then returns to normal. It is unfortunate that there is not available more information on acclimatized man. In the case of an adapted subject at work, Christensen found that the cardiac output and the capacity for oxygen transport were diminished. Theoretically, the cardiac output of the Andean should be considerable because of his slow heart beat and his capacity to carry on strenuous exercises.

In 50 per cent. of efficiency tests—with or without a brief tachycardia—the pulse becomes slower and then accelerates, reaching the initial normal rate. This paradoxical post-effort bradycardia, a fact never found in the physiology of the sea-level man, has been electrocardiographically recorded (Monge-Sáenz). In addition, brief periods of inverted P wave and shortness of PR, varying activity of the pacemaker, inconstant partial block and deviation of ST have been found, during which test the subject felt no fatigue. This differs from what Greene and Gilbert (1921) found in aviators during extreme oxygen want. We can assume that during the bradycardia period the heart fibers stretch to the utmost in an unaccustomed way. Heart dilatation and sudden death sometimes ensue in mountain sickness.

On the other hand, in 8 per cent. of the acclimatized subjects we found tachycardias, which started suddenly without any clinical distress, alternating with slower rates. Efficiency tests during this phase do not interfere with the initial acceleration. The pulse goes up and down keeping to the basic tachycardia, but at any moment the rate may return to bradycardia. Probably there is a sudden change in the pace-maker, but electrocardiographic records appear normal.

There is hypertonus of the vegetative nervous system, as proven by oculo-cardiac, Danielopoulo atropine and solar reflex tests (Monge, Pesce, Aste), during which the Andeans do not feel any distress at all, but the adapted men, on the contrary, frequently collapse. This explains the heart features we have just described. The increased vagal tonus, due to anoxemia, as Greene and Gilbert proved in 1921, in animal experimentation, seems to cause the bradycardia, which may be considered a feature of the altitude heart. In adaptation, after a time the slower rate probably becomes an intrinsic function of the heart muscle. The parallel activity of the sympathetic adrenal system contributes to the same result. This may explain the tachycardia of sinus origin, which constitutes another paradox of the heart rate at high altitudes. This hypertonus of the vagal-sympathetic system must have some connection with stability of the vasomotor center and reflex nervous system. Gebhorn's findings on man (1937) give an interpretation to the collapsing form of mountain sickness.

In discussing acclimatization the buffer capacity of the body has not been stressed sufficiently. The adapted and the acclimatized man have practically a similar alkaline blood reserve, but their behavior is quite different. We observed in 1928–1935 that the shift of the pH after work of about 700 kilogrammeters at high altitude either equals or is less than the values attained at sea-level. On the other hand, in adapted persons the difference in ionic concentration is three times higher. This gives an idea of the stability of the internal environment already outlined. We have established the fact of loss of alkali in men during ascent (1928). There is a reciprocal relation between the blood alkaline wave and the elimination of bases through the urine, measured by pH, the ammonia and the titration acidity (Monge). This pH correlation between blood and urine has just been found by Brassfield and Behrmann in animal experimentation. The condition is reversed on returning to sea-level (Monge). This change must be compensated to attain a normal buffer capacity.

Very little is known about the biological processes of tissue oxygen fixation and of restoring the buffer systems. It is generally conceded that there is an interplay of chemical reactions between blood and tissues to keep the fixity of the internal milieu. At high altitude internal respiration must be conditioned by its capacity to fix oxygen and its power to buffer and to release carbon dioxide. Guzmán-Barrón, Dill, Edwards and Hurtado have suggested that there is a disturbance of the oxydation-reduction system. Hurtado found increased myoglobin. We pointed out in 1928 higher venous oxygen saturation in adapted than in acclimatized subjects. It appeared as though the tissues had not taken it from the blood. Aste-Salazar recently found facts to support this. High venous saturation may also be interpreted as an effort to maintain the capillary oxygen pressure. So we suggested, "Altitude changes the capacity of the tissues to fix ogyen. We can assume there are some unknown tissue reactions which bring about acclimatization" (1928). But this entire acclimatization hypothesis must also consider the production, buffer, transport and release of carbon dioxide.

May I suggest that the native or acclimatized highland dweller possesses some of the biological characteristics needed in an aviator, and that perhaps a better knowledge of the physiology of a man born at an altitude of 15,000 feet might contribute to an understanding of conditions of fitness required for high altitude flying?

Physiology of Reproduction. Sometimes the adapted person's body and mind seem to be in excellent condition, but, surprisingly, he may prove completely sterile. A study of the fertility of rams brought from sea-level revealed that only 50 per cent. are able to produce offspring the first year; after two or three years the highest reproductive average reaches only 70 per cent. Thus 30 per cent. sterility seems to result. Rams acclimatized since Colonial times, on the contrary, reproduce 100 per cent. Eggs brought up from sea-level do not always hatch in high altitudes.

Sterility in rabbits, cats, horses and cattle has also been found. We produced aspermatogenesis in rabbits and cats. The pathological picture resembles that of cryptorchidism. San Martin has found that some dilutors for artificial insemination do not work in high altitudes, and this elucidates another altitude problem. If we consider these facts from an industrial point of view we can realize their importance because they affect the food supply and the economy of South American high plateaus. Similar disturbances sometimes occur in men who, though fertile at lower levels, prove sterile in the higher altitudes. History supports this observation. Father Calancha's writings (1639) describe the Spanish conquerors going to Potosí (14,000 feet) and having no offspring until fifty years after the city was founded. The mechanism, then, which enabled them to become acclimatized established itself slowly indeed. On the other hand, the average reproduction of the natives was 100 per cent. In 1639 the capital of Peru was transferred from Jauja (13,000 feet altitude) to Lima at sea-level because horses, fowl and pigs did not produce offspring at the higher altitude. Time does not permit me to give more examples.

But I do not want to create a wrong impression. The acclimatized population is always increasing. The average birth rate at 15,000 feet equals that of sea-level. We are convinced that there are both animals and plants with the superacclimatization power necessary to live on the high plateaus.

Sociological Behavior. The biological characteristics of men of the high plateaus mentioned are different from those of men at sea-level. That is why the men of the Andes may be considered as belonging to a climatophysiological variety of the human race. In fact, they are closely related to their geographical surroundings—altitude, radiation, humidity, ionization, and so on. The sociological behavior of such men and the telluric environment appear as one biological system which can not be divided, as a climatophysiological unit. So men must adapt themselves when they come down to the coast; they can not always stand the meteorological conditions of the lower lands; they become predisposed to disease of the lungs, as we have reported (1934). But the struggle for existence forces them to come down. Every year about one hundred thousand men come down to sea-level for agricultural work and then follows something worth noting: after about three months they go back to the altitudes; they never stay on the coast, no matter what it offers them. The reverse is true: if men go up to the mines, they soon return to sea-level. These peculiar annual migrations of high plateau societies are a well-known fact of biological significance. These persons are like migratory birds; they have the urge to return home. Thus, the Andean man has the same problems of acclimatization to face when going down to a land not always suited to his physiological equipment. I do not want to convey a wrong impression. Usually acclimatization on the coast is easier than in the highlands. But there are facts, the study of which is of the utmost importance to knowledge of the Andean population: these have to do with labor, assurance, migrations, army and health. With respect to these facts history is conclusive.

During the Inca period men of the high plateaus were allowed to colonize lands of the same climates only. When the highland peoples had to fight on the coast during the wars, they had two armies which they used alternatively, thus avoiding the climatic trauma of the lower lands (Garcilazo de la Vega, Padre Cobo). The Inca's sanitary legislation as well as that of the Colonial times recognized these facts and tried to codify them. The Republic is unaware of the problem, and that is why in a recent war (Bolivia-Paraguay) the climate of the tropical lowlands of central South America killed more people than the enemy's bullets. The lessons of history have been forgotten. The day will come when those vital matters will receive due consideration for the benefit of the human beings living in high altitudes. To this end we need education and research.

CHRONIC MOUNTAIN SICKNESS

From our point of view chronic mountain sickness means non-acclimatization, that is, impaired adaptation, and also loss of acclimatization. It may pass through a severe stage, so-called acute mountain sickness. To be born at high altitude does not confer immunity. Some of the features of this disease have already been outlined. We shall consider the severe forms of chronic mountain sickness only.

In regard to its symptomatology there is a perfectly characterized type which I have called erythremia of high altitude because it exactly resembles *polycythemia vera.* We must insist upon the fact that this disease is a clinical syndrome and not a hematological pattern. We can summarize it as follows:

At rest the patient appears reddish or blue, and he turns purple at the least effort. In cases of most severe involvement the scleras are intensely colored by the distended capillaries, the eyes being hidden behind edematous and bluish eyelids. The face is blue-violet, almost black, resembling that of an asphyxiated person. The mucous membranes are reddish. The tongue appears larger than normal and full of blood. All the superficial blood vessels appear dilated. Varices are common. Epistaxis is frequent; aphonia is usually noted. The hands show clubbing of the fingers. The nails become thick and appear to be inserted like watch glasses. The person resembles an old emphysematous, plethoric patient, walking slowly and heavily. He feels extremely weak and has a marked tendency to sleep. A state of drowsiness is found frequently. Spells of dizziness and fainting occur commonly. Nausea and vomiting at the least effort are noted occasionally; there are spells of diarrhea. Blurring of vision and temporary blindness are frequently observed. Transitory deafness occurs. Sometimes the patient suddenly falls into a kind of asphyxial coma for two or three hours, to return later to his pitiful condition. Aphonia, coughing and repeated bronchitis are present. Also recurring are congestive processes in the lungs accompanied with hemoptysis.

As the disease progresses, cardiac insufficiency ensues. In some cases symptoms of angina pectoris appear after exertion. Collapse occurs often. Hypertension happens rarely. In only two out of seventeen cases was the size of the spleen moderately increased.

Patients complain of a variety of algesias. Some of them have excruciating pains in the lower extremities; others have constant pain in the lumbar region or in the joints, particularly in the tendon attachments at joint cavities. These pains may subside spontaneously or may cease if the patient descends to a lower altitude. There may be violent cephalagia, subsiding after lumbar puncture or bleeding. Bleeding improves the condition immediately in such cases. Paresthesias are varied in type and in localization. Some patients complain of unpleasant sensations of heat in the face; others, of violent sensations of cold. One said he felt as if warm water were being thrown on his back. One had the sensation of the loss of one hand; another complained of "bandaged legs." Formication and sensations of being pricked by pins are frequent. Those symptoms are similar to aeroembolism, as described by Armstrong.

Some persons are rather predisposed to congestive cerebral syndrome (Monge, 1936). This appears as a spasm of painful headache, sensation of fullness of the head, of hot flushes on the face, photophobia, injection of ocular mucosa and blurring of vision, scotoma, lacrimation, vertigo, dizziness, pain in the abdomen, general sweating and vomiting. The pulse becomes slower. Cyanosis is intense. These crises may last some minutes or several hours. When this occurs, the patient sinks into drowsiness which passes into unconsciousness. Frequently, an epistaxis releases the stuporous condition and the patient improves. The spinal fluid pressure is remarkably increased. In a recent case, Arellano found that the spinal fluid pressure surpassed the highest mark of the Claude manometer. Repeated lumbar puncture relieves the patient. This syndrome may be interpreted by considering the recent findings of Armstrong, Michelsen, Thompson and Maurer, who observed an increase of spinal fluid pressure in animals exposed to anoxia. Walsh and Boothby, in a low-pressure chamber, have seen bubbles appear in man and have noted increased spinal fluid accumulation. Arellano's case and our findings (1938) probably have the same explanation. Hemiplegia is not uncommon. After a sojourn of several years at 4.6 km one patient developed the symptomatology of moderated erythremia. Suddenly one day he developed a moderate degree of palsy of the right arm and aphasia. After a few minutes the disturbance disappeared. Every morning thereafter the trouble returned and the patient was obliged to come down to the capital. He showed some impaired mental and physical condition, but after a few days appeared normal. Two months later he returned to the mountains, but after three weeks the trouble reappeared. The last time he went up he developed deep psychic disturbances, a confused mental state and symptoms of acute soroche. He was brought to the coast against his will. A few days later he was entirely recovered, but he could not remember what had happened. He was obliged to give up his work in high altitudes.

In a recent case, after several years of erythremic symptoms the patient found himself unable to work and he had a fear of traveling. He worried much about this. He said it was "a silly idea" but he could not help it. He saw everything wrong; he was afraid of meeting his employees at the saw-mill. Sometimes he got up at night and went to work; he realized that there was nothing to do, but he went there just the same. Finally he felt like a "criminal" or a "murderer" and he conceived the idea of committing suicide. Then he came down to sea-level and was immediately relieved; the mental disturbances disappeared. When he returned to the highlands the idea of suicide persisted. Under the circumstances, we kept him in Lima, where he was completely normal. In cases of severe involvement there may be marked disturbances in the behavior and memory of the patients. An engineer had attacks of mental confusion during which he would make gross mistakes in arithmetic and drawing. Even with knowledge that descending to sea-level would effect a cure, he could not take the initiative to make the trip.

Nervous exhaustion is very common. The patients complain frequently of sexual frigidity. We have seen albuminuria vanish when patients were brought to sea-level and return as soon as they went back to high altitudes. We have found persons with a syndrome of recurrent collapse, hyperventilation and attacks of tetany, who entirely recovered when brought to a lower region. Similar condition has been found by Hinshan and Boothby in aviators. Marked polycythemia is the characteristic feature in these patients, the red blood cells being as a rule between 7,000,000 to 9,000,000 in number and of larger size than at sea-level. The number of reticulocytes is increased also. There is a slight leukocytosis and essinophilia. There is a predominance of monocytes. Alterations in the process of clotting are observed. One patient had bleeding of the gums, but this disappeared as he went down to a lower level. In another case the patient had convulsive attacks accompanied by pupura and the presence of blood in the cerebrospinal fluid, all of which disappeared when he was brought down to sea-level. The bilirubin is highly increased. The pH of the serum diminishes during asphyxial attacks, while after the crisis has passed, it goes up to 7.50–7.70 (Aste-Salazar[1]). The alkaline reserve of the plasma is greater than that of a person who is acclimatized to high altitude. The concentration of hemoglobin in the blood is considerably increased, in one case reaching 179 per cent. (taking 100 as the value found at sea-level). The viscosity of the blood is increased. There is high blood volume (Hurtado) and diminished plasma volume. The oxygen saturation of the arterial blood is considerably decreased. Hurtado found 57 per cent. in one case, and Aste from 70 to 80 per cent. High venous blood saturation reaches normal levels when the patients improve at sea-level. High basal metabolism is found in severe cases.

Evolution of the Disease. As a rule the patients consult a physician only after the illness has been present for some time, and it can last usually from two to twenty years. Sometimes a patient becomes temporarily well even while staying at a high altitude. Usually, after a stay at sea-level a patient returns to a high altitude and lives there for some time without great discomfort. As time goes on, however, the cure at sea-level is less and less enduring, and asphyxial disorders may occur as soon as the patient reaches a high altitude. These disorders may sometimes cause death.

From this condensed description it is seen that the fundamental characteristic of high altitude disease, the characteristic which has made us group it as a nosographic entity, is the fact that all the symptoms subside or disappear as soon as the patient is brought down to sea-level. This feature is undoubtedly due to a common cause, anoxemia. The predominance of any symptom must be due to the fact that the particular organ involved has suffered great damage from the prolonged effects of lack of oxygen.

Besides these severe forms of chronic mountain sickness there are cases of subacute evolution, with slight impairment of physical and psychical conditions and a mild erythremic symptomatology.

At times one can find some individualized forms: pulmonary, cardiac, renal, digestive, etc. But a skilful clinician can always differentiate an erythremic complex. Silicosis, however, frequently displays an exaggerated symptomatology of chronic mountain sickness.

In conclusion it may be said that we have found a climatophysiological variety of human being and a climatopathological variety of human disease. But our work represents only a tentative effort in fields of education and research that are still unexplored.

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[1] Unpublished work.

LOW TEMPERATURE PHYSICS IN THE USSR

By Professor C. T. LANE
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THE extraordinary performance of the Russians on the Eastern Front has been a surprise to many people in this country. We had supposed that most Soviet industry was badly managed and Russian technicians, as a whole, inept. Those of us, however, whose interest in certain scientific fields had compelled us to pay some attention to Russian research were, I think, agreed that much of this work was of a high order and comparable in quality with the best American and British effort. Generally speaking, any nation with a healthy interest in pure research is likely to have a vigorous industry, and *vice versa.*

In the special field of low temperature physics Russian contributions both in the pure and applied domain merit special attention. At least two excellently equipped laboratories for such studies have been built in the past ten years. The best known of these is the Institute for Physical Problems at Moscow under the direction of P. L. Kapitza, but excellent work has also been done at the Physico-technical Institute at Kharkov under W. Schubnikov. It is probably a fair statement of fact to say that Kapitza is the most distinguished of all present-day Soviet physicists. He first appeared in England during the twenties at Cambridge, and, with Rutherford's backing, had very soon perfected an apparatus for the production of magnetic fields some ten times more intense than anything previously attained. During the period 1926–1930 a considerable number of fundamental papers on the properties of metals in high fields appeared from Cambridge. About 1929 Kapitza's interest appears to have shifted to low temperature work, probably because he recognized that such studies would be of prime importance in furthering our understanding of the metallic state. With funds supplied by Sir Alfred Mond he created, practically single-handed, the Royal Society Mond Laboratory at Cambridge for low temperature work. Almost all the equipment at the Mond is of a radically new design, and special mention should be made of the Kapitza helium liquefier there.

This machine marks a new epoch in the technique of gas liquefaction, and for the first time opened up the region of extremely low temperature research to smaller laboratories whose funds do not permit the expensive and highly specialized equipment previously necessary. The Mond liquefier was followed by one of similar type, designed by the writer, and built at the Sloane Physics Laboratory, Yale University.

Apparently Kapitza was in the habit of spending his summers in Russia, and in the fall of 1935 he failed to reappear at Cambridge for the fall term. The story current at the time was that he had been "detained" by the Soviet authorities, who explained that they needed his outstanding talents for Russia's own highly important and rapidly developing scientific work. However, in a letter to the writer in 1937, he stated that he had resumed his scientific work and seemed quite satisfied with his position in general. As head of the Institute at Moscow Kapitza has gone ahead in several directions in the low temperature field. He has built another helium liquefier based on his Cambridge design and equally successful. Although no technical details concerning this plant apparently have been published[1] it appears to be of somewhat better design than either the Cambridge liquefier or the Yale plant, and is probably the best liquid helium equipment in the world to-day.

A second outstanding piece of work has also come from his laboratory, and this merits our special attention since it apparently represents part of a widespread program in the USSR linking low temperature physics and industry. The Russians have instituted a new branch of engineering which they call "deep refrigeration," and much of this program appears to be under Kapitza's direction.[2]

This new industry is really an extension of one which has been practiced all over the world for a number of years (in one restricted field) namely, the production of oxygen, nitrogen and argon from atmospheric air. The Russians have been the first to realize that enormous quantities of valuable raw materials go to waste annually in various gases which are by-products of many industries. The problem has been to separate out the various pure components of these usually complex mixtures and so make available to the chemical industry an abundant source of raw materials for the manufacture of plastics, synthetic rubber, etc. Low temperature separation, *i.e.*, the progressive liquefaction and removal of the various components of a mixture made possible by the fact that each component has a different liquefaction temperature, has been found to be a very economical and practical method. It is clear, therefore, that any advance in the technique of gas liquefaction, while interesting scientifically, is likely to have an even greater industrial significance.

To return to Kapitza, he has recently perfected a new type of liquefaction apparatus which is quite different from anything so far attempted anywhere. While it has officially been applied only to the production of liquid air, it seems certain that the Russians are making wide use of it in their chemical industry, probably in plants making synthetic rubber and explosives. The actual machine, which makes use of a special type of low temperature turbine, is too complicated to be discussed in much detail in such an article as this, although some technical information is available.[3] The suggestion that a turbine might be a valuable type of machine for gas liquefaction is, to be sure, not a new one. It was originally due to the eminent English physicist, Lord Rayleigh, about the close of the last century. However, it soon became apparent that a practical turbine would have to run at an enormous speed, some 30,000 r.p.m., to be efficient, and at such speeds vibration becomes a serious problem. It remained for Kapitza to overcome these formidable technical difficulties, and the resulting apparatus appears from the published accounts to be very reliable and of exceptional efficiency. One enormous advantage lies in the fact that it operates at very low pressure while existing liquefaction equipment does not. This means that for large-scale equipment the cheaper and more efficient turbo-compressor could be used in place of the cumbersome and expensive multi-stage piston compressors now employed. It is probably not too much to say that all existing low temperature industrial equipment has been rendered obsolete by this development. In recognition of the importance of this work the Russian Academy of Sciences voted Kapitza a bonus of 25,000 rubles, together with premiums to his assistants.

While we are on the subject of low temperature physics in industry, it may be worth mentioning that another Russian physicist, M. Ruhemann, has recently published a most illuminating book on the whole subject of gas separation by refrigeration.[4] Ruhemann is a product of the Kharkov Institute and judging by the number of publications by him on the subject which have appeared in various English and Russian journals, he also has taken a leading part in the establishment of this new industry. The book is highly technical, but would certainly repay close study by any one interested in this field.

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[1] A photograph of the plant appears in *Phys. Zeit. d. Sowjetunion*, 12: 497, 1937.

[2] *Nature*, 148: 860, 1941.

[3] P. Kapitza, *Jour. Physics*, USSR, 1: 7, 1939.

[4] "The Separation of Gases," New York: Oxford University Press, 1940.

One instance, apart from gas separation, of some of the problems which have been solved in the USSR should prove of interest to scientists in this country. The so-called "natural gas" found in and adjoining oil fields consists largely of methane. This gas is much superior to ordinary illuminating gas in calorific value, but, more surprising, it is an excellent anti-knock fuel for internal combustion engines. The difficulty lies in storage, since a cylinder designed for 150 atmospheres pressure weighs about ten times more than the methane it contains. However, a tank 20 × 15 × 10 feet could hold as much methane (liquid) as a two million cubic foot gas-holder and would be immeasurably cheaper and less dangerous. The advantages of such a scheme are obviously very great—such stored gas would be of great value in emergencies or when sudden and heavy industrial demands on fuel gas occur.

Despite all this industrial activity in recent years, a good deal of purely "academic" research of high quality has come from Kapitza's laboratory. One such outstanding contribution was made during the current year and reported in the *Physical Review*. This had to do with the properties of liquid helium. Kapitza had earlier discovered that liquid helium at a temperature some two degrees above absolute zero (so-called Helium II) behaves like an "ideal" fluid, apparently possessing a vanishingly small viscosity or fluid friction. It appears from this latest work that Helium II flows in narrow channels without change in entropy and accordingly is truly a super fluid. We must therefore regard this substance as being unique—nothing like it has ever been previously observed. The significance of this discovery for modern atomic physics is likely to be of the greatest importance.

The whereabouts and activities of Kapitza since the German invasion are not known. It is probable that his purely scientific work has been interrupted although likely that he is still engaged in his industrial activities.

THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL: THIRD PROGRESS REPORT

By Dr. LEONARD CARMICHAEL

PRESIDENT OF TUFTS COLLEGE, DIRECTOR OF THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

IN previous reports[1] an outline has been presented of the basic plan and the preliminary steps taken in the construction of the National Roster of Scientific and Specialized Personnel. In the present report emphasis is given to a description of the actual operation of the Roster as it appears at the close of the first year of performance.

So far, more than 200,000 names of individuals are listed in the analytical files of the Roster. It is interesting that from this list already more than 50,000 names have been presented to various defense agencies and other government bureaus for consideration in connection with appointments. Almost all the requests that come to the Roster office are of a confidential character and it is not possible at this time to describe them. It can be said, however, that especially large numbers of demands have been presented for individuals in the fields of physics, electrical engineering, aeronautical engineering, marine engineering and mechanical engineering. Significantly large numbers of requests have also been received for individuals with special language skills or with a combination of some other professional competency and language skill. There have been demands also for a good many economists and psychologists, and, indeed, there have been some requests for men in each of the fields covered by the Roster. The fields for which technical check lists have so far been prepared are as follows:

- Administration and Management, including separate lists in:
  - Accounting
  - Management Engineering
  - Personnel Administration
- Agricultural and Biological Sciences, including separate lists in:
  - Animal Sciences
  - Botany
  - Forestry and Range Management
  - Genetics
  - Plant Pathology, Horticulture and Agronomy
  - Zoology and Entomology
- Engineering and Related Fields, including separate lists in:
  - Aeronautical Engineering
  - Architecture

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[1] SCIENCE, August 16, 1940, Vol. 92, No. 2381, pages 135–137, and SCIENCE, March 7, 1941, Vol. 93, No. 2410, pp. 217–219.

  - Automotive Engineering
  - Chemical Engineering
  - Civil Engineering
  - Electrical Engineering
  - Heating, Ventilating, Refrigerating and Air Conditioning Engineering
  - Industrial Design
  - Mechanical Engineering
  - Mining and Metallurgical Engineering and Mineral Technology
  - Motion Pictures—Engineering, Production, Direction
  - Naval Architecture and Marine Engineering
  - Radio Engineering
  - Safety Engineering
  - Testing of Materials—Engineering and Technology
  - Transit and Traffic Engineering
- Humanities
  - Foreign Languages
- Medical Sciences and Related Fields, including separate lists in:
  - Anatomy
  - Bacteriology, Immunology and Pathology
  - Nutrition
  - Pharmacology and Experimental Therapeutics
  - Physiology
  - Tropical Medicine (and Parasitology)
- Physical Sciences, including separate lists in:
  - Actuarial Science
  - Chemistry
  - Geology
  - Geophysics
  - Horology
  - Mathematics
  - Physics and Astronomy
- Raw and Manufactured Products and Associated Industries:
  - Speleology
- Social Sciences, including separate lists in:
  - Anthropology
  - Economics
  - Geography
  - History and Political Science
  - Psychiatry
  - Psychology
  - Recreation Leadership
  - Sociology
  - Social Welfare
  - Speech Pathology
  - Statistics
  - Trade and Industrial Education

A few examples of the sort of requests which come to the Roster from non-confidential sources may give an indication of the character of demands in the confidential areas as well.

The Bureau of Mines of the Department of the Interior requested names of chemical engineers skilled in extractive metallurgy, especially in the field of aluminum.

The Interstate Commerce Commission requested a transportation economist capable of assuming responsibility for conducting independent research and using statistical data in the investigation of the economics of transportation.

An investigating committee of the United States House of Representatives requested the names of experts in the fields of economics, sociology, transportation and job statistics to perform research and analysis in connection with national defense migration.

The Office of Price Administration and Civilian Supply requested a number of mathematical statisticians.

Engineers of various types have been requested for the Panama Canal Zone.

The Office of Production Management has requested, under specific description, more than thirty economists skilled in such fields as brass, cadmium, hides, rubber, cork and miscellaneous metals.

The National Youth Administration requested the names of individuals eligible for appointment as radio engineers to provide advisory service to state administrators in connection with the training of young radio operators.

From the Securities Exchange Commission a request for statisticians in securities and corporate finance has been received.

The examples given above hardly give a fair picture of the work of the Roster because by far the largest number of individual requests that have come to the office have been from the Army, Navy and other services in which information is at the present time restricted. Nevertheless, these examples may show something of the highly specific character of the demands which are made upon the Roster concerning citizens who have had very specialized training.

Some of the individuals for whom confidential requests have come are: translators of many languages; maritime reporters; physical chemists; radio physicists; industrial chemists; women physicists; explosives chemists; specialists in European history; electrical, mechanical, chemical, civil, sanitary, safety, aeronautical, marine, motion picture, and other engineering specialists; business specialists; personnel administrators; petroleum economists; statisticians with ability to speak Spanish; research physicists with experience in testing strength of materials; recreation supervisors; topographers; accountants; industrial commissioners; economists for monetary research; economic geologists; physicists with expert knowledge of oscillographs; psychologists for personnel testing; physicists for research in optics; safety experts; experts in hydro-dynamics; psychologists with expert knowledge of vision and audition; x-ray experts; public administrators; labor representatives; industrial training coordinators; experts on import and export problems of clearance; experts in labor relations; ordnance experts; nutrition chemists; speech pathologists; physiologists with experience in high altitude research; budget examiners; architectural inspectors; examiners with knowledge of Polish; personnel placement officers; and many others.

From time to time those in charge of the administration of the Roster have secured statistical data concerning its growing file. At one time, for example, the percentage of men and women listed was determined for the entire file. While names have been added since that time, it is presumed that this ratio has not changed materially. The numbers indicated are: men, 142,845; women, 8,881. The median age of Roster registrants, based on a similar procedure, was found to be 37.65.

At the time when the total registration of the Roster included 151,726 individuals, a study was made of the distribution of those registered by professional field, and at the same time a study was made of the academic training of those registered. It should be emphasized that selective factors have determined the academic level of the individuals listed on the Roster. For example, circularization in certain fields of the humanities has been limited to those who have pursued studies equivalent to those ordinarily required for the Ph.D. degree, whereas in other fields all individuals who have received Bachelor's degrees and whose names could be secured by the Roster have been listed. It should be added that there are no minimum educational requirements for inclusion in the Roster. The number of individuals in various fields and their educational level are given as of September 1, 1941, in the table below.

Dr. Steuart H. Britt, of George Washington University, has been serving as a special consultant of the Roster to deal with the problem of the relationship between the Roster and the Selective Service System. After consultation with leading academic authorities in the fields of specialization for which there is the greatest demand because of the defense effort, Dr. Britt has worked out a procedure by means of which information on the Roster concerning a man's accomplishments may be made available, through the national and state boards, to the local boards of the Selective Service System for their own evaluation. Emphasis should be given to the fact that this relationship between the Roster and the Selective Service System is wholly of an advisory character. The procedure employed by the Roster in this work has been to use the selecting card sorter and to tabulate the names of those individuals on the Roster whose age is such that they are subject to call by the action of the Selective Service System. Special questionnaires are forwarded from the Roster office to these individuals requesting information concerning their status with their local boards. On the basis of this information and information contained in the individual's questionnaire as originally filled out, authorities in the man's special field are asked to advise the Roster concerning the training of the man in question in relation to necessary defense work. The registrant's employer, as well as others having knowledge of his technical competences, is also asked to furnish information concerning his qualifications.

DISTRIBUTION OF INDIVIDUALS REGISTERED WITH THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL BY PROFESSIONAL FIELD AND EXTENT OF EDUCATION SEPTEMBER 1, 1941

Field of specialization	Extent of education					
	Doctor	Master	Bachelor	4 Yrs. Coll. No Degree	Others	Total
Languages	2,785	1,607	1,598	116	566	6,672
Genetics	435	164	82	13	61	755
Zoology	1,500	975	597	28	294	3,394
Physiology	554	50	13	1	....	618
Botany	741	247	79	3	6	1,076
Bact., Immu., Path.	1,384	340	369	25	56	2,183
Anatomy	484	25	13	1	3	526
Tropical med.	245	30	18	....	5	298
Chemistry	7,345	7,378	19,093	1,242	3,394	38,452
Physics	2,507	1,679	1,335	82	218	5,821
Mathematics	1,502	1,838	880	31	44	4,295
Geology	932	1,020	1,996	147	484	4,579
Actuarial sci.	9	96	278	8	100	491
Speleology	17	6	13	2	26	64
Horology	....	....	16	2	663	681
Civil eng.	135	1,616	5,825	291	1,357	9,224
Marine eng.	4	76	313	51	269	713
Safety eng.	9	41	366	59	585	1,060
Traffic eng.	2	31	125	8	100	266
Radio eng.	108	348	905	73	704	2,138
Testing mat. eng.	70	211	567	36	237	1,121
Chemical eng.	331	595	1,915	138	317	3,296
Electrical eng.	228	1,339	5,402	219	1,205	8,393
Mechanical eng.	117	1,055	4,500	288	1,478	7,438
Motion Pict. eng.	2	12	69	9	124	216
Automotive eng.	48	215	1,047	99	1,145	2,554
Aeronautical eng.	55	328	1,627	139	988	3,137
Management eng.	103	309	1,136	98	1,114	2,760
Heating and vent. eng.	19	159	851	95	696	1,820
Mining and met. eng.	335	856	2,733	154	612	4,690
Economics	1,103	867	425	17	105	2,517
Accounting	1	42	176	36	393	648
Psychology	1,957	1,013	181	7	10	3,168
Anthropology	281	147	95	14	32	569
Hist. and pol. sci.	2,120	1,307	413	17	64	3,981
Personnel adm.	348	1,350	1,178	100	608	3,584
Speech pathology	70	110	39	....	10	229
Statistics	595	615	517	29	108	1,864
Geography	231	171	98	8	56	564
Sociology	472	301	133	4	23	933
Recreation leadership	33	311	650	52	185	1,231
Plant path., hort. and agr.	1,020	839	642	21	69	2,591
Forestry and range mgmt.	136	982	2,272	71	418	3,879
Animal sciences	350	684	5,887	57	259	7,237
	30,723	31,454	66,467	3,891	19,191	151,726

It is recognized that especially because of the changing activities brought about by the national emergency, information secured a number of months ago may rapidly become obsolete. The Roster has, therefore, arranged a procedure by means of which the entire card index may be run through and those cards selected which have been in the files for twelve months. All such individuals receive a special abbreviated questionnaire asking them to fill in blanks which indicate changes in status which have occurred during the previous year. This recircularization procedure is just beginning.

Because of the fact that many of the demands that come to the office of the Roster require the services of young scientists with advanced training, it has been decided this year to add to the lists of the Roster the names of all young men and women who are expected to graduate from colleges and technical schools in 1942, provided they are carrying on major work in physics, mathematics, astronomy, chemistry, geology or any of the engineering fields.

Recently, due to demands from the Office of Production Management, special procedures have been worked out by means of which accredited governmental agents may use the facilities of the Roster in connection with the needs of rapidly developing private defense industry. In this work, as in all other aspects of the operation of the Roster, every effort is made by the staff and by the scientific and technical consultants, who are called together for the purpose, to emphasize the conservation aspects of the work of the Roster. If it were not for the limits imposed upon the office because of the confidential nature of the work which the Roster carries out, it would be possible to give hundreds of examples of individuals who have been allowed to continue in educational work, defense or even non-defense research of an important character as a result of the operation of the Roster. This means that by using the large lists available in the Roster office, it is possible to suggest alternative names to individuals who are very anxious to call from one defense agency to another some important man. In a similar way, going enterprises in education and public health research, for example, have been safeguarded.

It is clear that the work of preliminary evaluation and of consultation with various defense agencies requires continued and active supervision. The writer of this report is in Washington on an average of only two or three days each week, so the general burden of the development and effective administration of the Roster in all its aspects falls upon Mr. James C. O'Brien, who from the first has been the efficient executive officer of the project. There are slight fluctuations in the number of individuals employed in clerical and other capacities in the Roster office, but the average figure of those employed may be set at 100.

The writer can not resist once again emphasizing the fact that the Roster seems to have so many implications for peace-time as well as war-time economy that it is our profound hope that this new and effective agency for dealing with America's highly trained citizens may not be thought of wholly in war terms, although at the present time almost all its activities are specifically of a defense character. It seems quite clear to those who are working with the Roster that in time of peace as well as in war a great central list of this sort will be advantageous to the country as a whole and especially advantageous to the scientists and specialized workers who are listed on the Roster.

OBITUARY

ELSIE CLEWS PARSONS

DR. ELSIE CLEWS PARSONS, president of the American Anthropological Association, died on December 19 after an operation, just before she was to preside at the annual meeting of the association.

Dr. Parsons' anthropological work is outstanding both by the quality and the wide extent of her contributions. Her early publications on sociological questions relating to our present civilization were in part influenced by the teachings of Giddings, but reflected at the same time her intense devotion to individual freedom. She was one of the early champions of the rights of women, a vigorous opponent of the recognition of any form of status to which a person is born or assigned, and she lived her life according to her convictions, which demanded social responsibility combined with individual tolerance.

Later on she turned to anthropological studies of a different character, largely prompted by the feeling that we need an understanding of foreign cultures in order to enable us to evaluate clearly the problems that have to be solved in our own civilization. Her interest was challenged, perhaps accidentally, by observation of the Indians of New Mexico and Arizona. The contrast between their cultural behavior and our own, the influence of cultural forms upon personalities, the ways in which personalities similar to those found in our own civilization respond to the demands of their culture, were problems that challenged her attention. Combined with this was an insatiable demand for ample and reliable factual information for supporting her deductions, which accounts for her prolific writings.

The study of the ceremonials, customs and folk-lore brought home to her the importance of the influence of Spanish civilization upon the American Indian, and with ever-expanding appreciation of the importance of this problem she extended her work over other

Spanish-American countries. One of the most mature results of these studies is her book on Mitla, a Mexican town in which ancient attitudes and Spanish influences are blended in a remarkable way. Her very last investigation, which she had just completed, bears on the same subject as expressed among the Indians of Ecuador.

Her two-volume work, "Pueblo Indian Religion," published in 1939, contains a summary of practically all we know about Pueblo religion and is an indispensable source book for every student of Indian life. Besides the results of her own investigations it contains a critical summary of the vast literature related to this subject.

It is impossible to do justice to all her writings, every one of which shows her painstaking desire for accuracy and furnished new materials for her own studies and for those of others. Her own investigations extended not only over the Pueblos, Mexico and recently also South America, but she also collected among American Negroes in the United States as well as in the Bahamas, Haiti, the Lesser Antilles Islands, among the Portuguese in New England and many Indian tribes of the Plains.

The importance of her work should not be judged alone by the quantity of reliable and carefully digested material but even more so by the uses to which she put the results of her investigations. She was one of those whose scientific insight shapes their life. Conscious through her studies of the far-reaching influence of tradition, she was averse to the ardent spirit that would throw aside the past and rebuild society on theoretical grounds; an enemy of all catch phrases that beguile us and skeptical of the beautiful words that promise a better future, but that are not liable to be kept by those who glibly pronounce them, not as she believed on account of their bad faith, but because freedom of the mind and willingness to forego old accustomed prejudice must be attained before we can hope for a better future.

In Elsie Clews Parsons we have lost not only an unusually productive and painstaking scholar but also a woman who used her great opportunities wholeheartedly in furthering the science in which she was interested. She followed the work of the younger students with keen interest, and wherever it was in her power she helped them unstintingly to carry on their work, both with material means and with sound advice, without expecting any return except opportunity well used. Social science in all parts of the country owes her an unmeasurable gratitude. It is not saying too much to claim that the successful work of the American Folk-Lore Society could not have been done without the energy and time that she put into it.

She was in every way a power for good in our society. She will be sorely missed by all her friends, and her death is a loss to the nation.

FRANZ BOAS

COLUMBIA UNIVERSITY

DEATHS AND MEMORIALS

DR. HARRY WARD FOOTE, professor of physical chemistry at Yale University, a member of the faculty for the past forty-two years, died on January 14 at the age of sixty-six years.

DR. ALFRED SIMPSON TAYLOR, professor of clinical surgery in the department of neurology of Cornell University Medical College, died on January 16 at the age of seventy-three years.

PAUL GOODWIN REDINGTON, forest supervisor of the U. S. Forest Service, formerly chief of the U. S. Biological Survey, died on January 12. He was sixty-three years old.

CHARLES ANDREW MCCUE, dean of the School of Agriculture, formerly professor of horticulture of the University of Delaware, died on January 12 in his sixty-third year.

PROFESSOR ÉMILE PICARD, permanent secretary of the Paris Academy of Sciences and a distinguished mathematician, died on December 12, aged eighty-five years.

THE centenary of the birth of William James was observed at the University of Wisconsin on January 12 and 13 by a meeting at which 600 philosophers and students of philosophy were present. Among the speakers were: Dr. J. Seelye Bixler, of Harvard University; Dr. Boyd H. Bode, of the Ohio State University; Dr. Max Otto, of the University of Wisconsin, and Dr. Dickinson S. Miller, formerly of Columbia University. A paper by Dr. John Dewey, who is spending the winter in Florida, was read.

SCIENTIFIC EVENTS

ADJUSTMENTS IN THE EDUCATIONAL PROGRAM AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

AN official statement has been issued by the Massachusetts Institute of Technology announcing that it does not plan to adopt the extreme "speed-up" plan which many colleges have adopted as a war emergency measure. The Corporation approved on January 9 a faculty recommendation to this effect. After careful analysis it has been decided that adoption of the "speed-up" plan would weaken rather than strengthen the total contributions of the institute to the war effort, and would retard rather than expedite effective service by its students. This decision was arrived at after wide discussion with Army, Navy and industrial officers who are thoroughly aware of the urgent need for well-trained engineers and scientists.

In discussing this decision President Karl T. Compton pointed out that the principal objection to the "speed-up" plan which contemplates continuous concentrated college study, summer and winter after secondary school graduation, is that the additional yield would consist at the most of only about twelve thousand engineering graduates in the entire country, no difference for how many years the "speed-up" program is continued, and this gain would be offset by their inferior training and by necessary curtailment of the special emergency training courses through which the engineering colleges are now turning out technical specialists in much larger numbers than they are graduating regular students.

The need for well-trained engineers and scientists is recognized by the Selective Service Administration, which recommends that students in these fields, who give evidence of professional promise, be permitted to complete their academic programs. Similarly Britain has been forced, through the technical requirements of the war, to place scientists and engineers in special categories—even to the extent of forbidding their engagement in the war effort outside the field of their professional competence.

Though not favoring the extreme "speed-up" plan, the faculty of the institute voted to accelerate the program for this year's senior class to permit graduation on April 27, and has authorized substitution of special study and training in subjects important for the war effort in place of certain professional and non-professional requirements of the normal curriculum.

THE FINLAY INSTITUTE OF THE AMERICAS

According to the *Journal* of the American Medical Association, at a meeting on January 6 at the Medical School of the University of Havana, it was decided to establish "The Finlay Institute of the Americas to encourage research and education in the field of tropical disease and to provide for an increased interchange of medical students and teachers among scientific medical institutions in all the American nations." Officers were elected as follows: Basil O'Connor, president of the National Foundation for Infantile Paralysis, president of the executive council; Dr. James E. Paullin, president-elect of the American College of Surgeons, chairman of the Scientific Advisory Committee for the United States. Members of the executive council include: Dr. Thomas Mackie, president of the American Society of Tropical Disease; Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association; Dr. Edgar Mayer, associate professor of medicine at Cornell University and the University of Havana; Dr. Enrique Saladrigas, director of the Finlay Institute of the University of Havana; Dr. Rafael Menocal, professor of surgery at the University of Havana, and Dr. Felix Hurtado, assistant minister of public health of Cuba. During the course of the negotiations for the establishment of the institute Mr. O'Connor presented to President Batista of Cuba and to the minister of public health, Dr. Marruz, messages from President Roosevelt and Vice-President Henry Wallace, indicating their approval of the project to foster more intense cooperation between scientific institutions of the Latin American countries. Donald Nelson, who accompanied the party to Cuba, also conferred with President Batista.

The *Journal* reports that during the course of the negotiations, the University of Havana and the medical school of the university provided receptions by their faculties, and addresses were made by the American visitors and also by leading Cuban officials. Representatives of the Cuban Federation of Medicine also presented to the American delegation an offer of complete cooperation in the campaign for medical service in the war. The order of Carlos Finlay was conferred on the American visitors by President Batista.

A constitution and by-laws are being prepared for the conduct of the institute. Executive offices will be established both in Havana and in New York. The Cuban Government has agreed to provide $20,000 annually for maintenance of the organization. Substantial contributions were made by several American industrialists and philanthropists.

THE GENETICS SOCIETY OF AMERICA

The Genetics Society of America, at its annual business meeting held in Dallas, Texas, on December 30, announced the election of Professor E. W. Lindstrom as president for 1942 and Professor Marcus M. Rhoades as vice-president.

The members assembled at this meeting also adopted the following resolution:

> Whereas, It is recognized that the growing burden of national defense makes it desirable and necessary for the Federal Government to practice utmost economy with regard to all non-essential expenditures; and
>
> Whereas, The continuity of fundamental research, which now has been destroyed by war in almost all parts of the world, is probably the most important investment that can at present be made for the benefit of the postwar period; and
>
> Whereas, It is to be hoped that the strength of the American form of government will be demonstrated by preserving the continuity of research work in this country;
>
> *Therefore, Be it resolved* by the Genetics Society of

America to urge upon Congress and upon the Federal Government the importance of safeguarding the continued prosecution of fundamental research by those institutions which are now supported by federal funds; and

Be it resolved, further, that the secretary of the society be instructed to transmit this resolution to the Secretary of Agriculture, to the Secretary of the Association of Land-Grant Colleges and Universities, and to such other persons as may seem advisable.

THE WESTERN SOCIETY OF NATURALISTS

THE fourteenth annual winter meeting of the Western Society of Naturalists was held at Stanford University on December 29, 30 and 31. The sessions were attended by between seventy-five and a hundred members and guests. Three symposia were presented, as follows: "Determination, Differentiation, and Regulation in Animal Morphogenesis," *chairman,* Professor R. M. Eakin, University of California at Berkeley; "Some Western Highways of Learning," *chairman,* Dr. D. L. Fox, Scripps Institution of Oceanography of the University of California, La Jolla; "The Genetic Basis of Evolution," *chairman,* Professor H. L. Mason, University of California at Berkeley. Fifteen voluntary papers were presented.

On the evening of the first day at an informal reception and smoker, Dr. Ray Lyman Wilbur, president of Stanford University, gave a short address of welcome to members. President Wilbur's message was followed by a short skit by Professor Francis B. Sumner entitled "The Philosophical Basis of Pediatrics." Professor Arthur W. Meyer then presented some little-known chapters in the development of embryology at the time of von Baer, under the title, "A Notable Trilogy."

After the annual dinner on the following evening, the secretary read a short response in verse to Professor Sumner's notable address of the previous evening. Professor Gordon H. Ball, retiring president of the society, then delivered the address of the evening entitled "Parasitism and Evolution."

At the business meeting, the members voted to seek means of utilizing some of the funds in the treasury of the society for the purchase of U. S. Defense Bonds.

Officers elected for the year 1942 are as follows:

President: C. H. Danforth (Anatomy), Stanford University.

Vice-president: I. L. Wiggins (Botany), Stanford University.

Members-at-large: R. M. Eakin (Zoology), University of California at Berkeley; Carl Epling (Botany), University of California at Los Angeles.

THE PERIOD OF INTERNSHIPS IN NEW YORK CITY

DR. WILLARD C. RAPPLEYE, commissioner of hospitals of New York City, announces that in view of the urgent needs of the Army and Navy, the municipal hospitals of New York will modify their internships to a one-year period of training, in order to assist in the recruitment of medical officers for the armed services. The general plan contemplates that the basic internship shall be one year. Those who complete that service and are not eligible for a commission, because of physical defect or other reasons, may remain as residents either in the general services or on a special service. He stated that a certain number of residents will probably be permitted to continue their advanced training in special fields of medicine in order to insure a sufficient supply of specialists for the armed services and for civilian needs in the future.

The Department of Hospitals and its Advisory Council, comprising representatives of the medical boards of all the municipal institutions, are advising that all interns and residents eligible for military duty be urged to apply for a commission in the Medical Corps of the Army or the Naval Medical Corps Reserve. Under the existing rules of the Selective Service system, the local boards ordinarily will not defer interns beyond twelve months of hospital training. Residents and interns who do not apply for commissions will automatically come under the provisions of the Selective Service system and their cases will be disposed of in the usual manner by local boards.

Under the new program of the Procurement and Assignment Service, which is under the office of the Defense Health and Welfare Services in Washington, advisory committees to this Procurement and Assignment Service will be set up in each corps area of the United States. The function of these advisory committees is to assist in the recruitment of the medical personnel of the various Government services, and also to select these residents and others for advanced training in special fields or to help protect essential hospital services in the local communities. On these advisory committees to the corps area services are representatives of the hospitals, medical schools, the medical profession, dentists and veterinarians.

The department is asking that staff members of municipal hospitals be prepared to give more time and attention to their hospital work in order to insure adequate and proper care of the patients and to offset the growing shortage of interns and residents. It is expected that attending staff members who have recently been retired because of age, but who are still available for active duty, may be called upon to assist in this program.

AWARD OF THE COPLEY MEDAL OF THE ROYAL SOCIETY

THE Copley Medal of the Royal Society was awarded to Sir Thomas Lewis at the anniversary meeting of the society held on December 1. In presenting the medal Sir Henry Dale said:

Lewis's life work, still in vigorous progress but for interruption by war duties and war conditions, has been the application of precise and controlled methods of experimental research to problems of clinical medicine. This has enabled him to achieve a detailed analysis of abnormalities of function produced by disease, injury or hereditary defect; and so far his attention has been centered upon the circulation of the blood and its disorders. Being attracted through the work of the late Sir James Mackenzie to the study of abnormal rhythms of the human heart-beat, Lewis recognized, about 1908, the great opportunity for a closer investigation of them offered by the then recent introduction of the string galvanometer by Einthoven. With its aid Lewis had soon made a number of clinical and laboratory studies, such as those in which he finally identified auricular fibrillation as the cause of a particular kind of complete irregularity. He was thus led to undertake, and to extend, with a succession of collaborators from many countries, the remarkable series of investigations, carried through in logical sequence between 1910 and 1923, in which he passed from the laboratory to the clinic and back again as the occasion demanded. It is fitting that special mention should here be made of the series of experimental studies published in our own *Philosophical Transactions* from 1914 to 1916, and presented in brilliant summary by Lewis in his Croonian Lecture to the society in 1917. In these were traced, with an astonishing precision of measurement and timing, the point of origin and exact course of the rhythmical waves of excitation and contraction in the normally beating heart of the dog, and, finally, for comparison, in the hearts of other classes of vertebrate animals. Considered by itself, this work ranks as one of the outstanding achievements of experimental physiology in our times, and it has given to physiology a large part of its present detailed knowledge of the nature of the heart-beat. For Lewis, however, its greater importance lay in giving to clinical medicine the background for an accurate picture of disturbances of the normal mechanism, therewith a new security of diagnosis and prognosis in dealing with disordered actions of the heart, and ultimately a rational basis for their treatment. A new phase of cardiological thought and practice spread rapidly from Lewis's clinic round the world.

Meanwhile he had begun in 1917, and was to maintain with a series of collaborators for more than another decade, a separate series of investigations, dealing by direct experiment with the blood vessels of the human skin. Thus were elucidated the means by which the resistance of these vessels to the flow of blood is maintained and varied, including their complex reactions to chemical substances akin to histamine, which he proved to be released from the cells of the epidermis by injurious or irritant stimuli. These methods of investigation were later developed and extended to vascular disorders of the limbs, and the experiments of still more recent series have dealt with pain and functional defects in muscles and nerves, due to interruption of the blood supply. Apart from the separate accounts of items and stages of these lines of research, as completed, in papers which have issued from his department in steady sequence, Lewis has assembled and discussed the results, in their appropriate connections, in a succession of comprehensive monographs. He has been the inspiring leader of a group of younger workers in clinical research as an experimental science, has founded a society for such studies and has devoted to their use a journal which he had founded with a more limited scope.

The work of Thomas Lewis, which we honor to-day with the highest recognition in the gift of the Royal Society, is renewing and carrying forward, with a special directness, the great tradition which William Harvey created, before this society was founded.

SCIENTIFIC NOTES AND NEWS

EUGENE GIFFORD GRACE, president of the Bethlehem Steel Corporation, has been awarded the Bessemer Gold Medal for 1942 by the British Iron and Steel Institute.

MAJOR HARRY G. ARMSTRONG, in charge of research at the U. S. Army School of Aviation Medicine at Randolph Field, Texas, has been given the John Jeffries award of the Institute of the Aeronautical Sciences in recognition of his researches in the physiological and psychological effects of flying at high altitude and in high-speed maneuvers.

IT is reported in *Nature* that the Symons Gold Medal for 1942 of the Royal Meteorological Society has been awarded to Dr. J. S. Owens, whose death occurred on December 6. This medal is awarded biennially for distinguished work in connection with meteorological science. The presentation was made at the annual general meeting of the society on January 21.

DR. JULIAN C. MILLER, professor and head of the department of horticulture at the Louisiana State University, has been elected president of the American Horticultural Society.

ARTHUR F. VAN DYCK, manager of the industry service section of the RCA Laboratories, was inducted at the recent New York meeting on January 12 as president of the Institute of Radio Engineers. He succeeds Dr. Frederick Emmons Terman, professor of electrical engineering and head of the department at Stanford University.

ERNEST BATEMAN BLACK, consulting engineer of Kansas City, has been elected president of the American Society of Civil Engineers. Charles M. Spofford, of Boston, and Thomas E. Stanton, of Sacramento, Calif., have been elected vice-presidents.

James G. McDonald has resigned as president of the Brooklyn Institute of Arts and Sciences. Mr. McDonald, who is a member of the Board of Education and a partner in the firm of W. A. and A. M. White Company, stated that his resignation, which is to take effect on March 1, is due to the exigencies of the war. Adrian Van Sinderen, who has been first vice-president of the institute for many years, has been elected to succeed him.

The Mathematical Association of America held meetings at Lehigh University on December 31 and January 1, in conjunction with the meetings of the American Mathematical Society, the Association for Symbolic Logic and the National Council of Teachers of Mathematics. On Thursday morning papers were presented by Professors Tibor Radó, C. R. Adams and N. H. McCoy, and on Thursday afternoon by Professors H. A. Rademacher, B. L. Newkirk and T. L. Smith. Professor Tomlinson Fort, of Lehigh University, was elected first vice-president, and Professors W. L. Ayres and R. L. Wilder were elected governors-at-large. Regional governors were chosen at the time of the meeting to represent seven of the fourteen regions into which the United States and Canada are divided.

Dr. Ira L. Baldwin, professor of agricultural bacteriology and assistant dean of the College of Agriculture of the University of Wisconsin, was reelected secretary of the Society of American Bacteriologists at the recent Baltimore meeting. He was, however, compelled to resign on account of ill health. He is succeeded as secretary by Dr. William B. Sarles, associate professor of agricultural bacteriology. The following resolution in honor of Dr. Baldwin was adopted by the society:

> The Society of American Bacteriologists considers itself to have been honored by the devoted and distinguished services which Dr. Ira L. Baldwin has rendered as secretary-treasurer. It has profited and prospered under his careful and considered guidance. The influence of the society has grown immeasurably. Its membership has increased extraordinarily. These are not the results of simple chance. They stem from the devoted industry and sympathetic guidance of a faithful and beloved servant of our science. In complying with Dr. Baldwin's wishes, the society accepts his resignation from office with genuine reluctance and regret.

The retirement is announced of Dr. Albert Galloway Keller, professor of the science of society at Yale University. A dinner was given in his honor on January 18 at which President Seymour was one of the speakers. Dr. Keller, who will reach the retiring age of sixty-eight years in April, will take leave of absence until his formal retirement in June.

Dr. George Russell Harrison, professor of physics and director of the research laboratory of experimental physics at the Massachusetts Institute of Technology, has been appointed dean of the School of Science. He will succeed Dr. Samuel C. Prescott, dean since 1931, who will retire on July 1.

Dr. Howard E. Fritz has been made director of research of the B. F. Goodrich Company, Akron, Ohio. Dr. Fritz, who has been connected with the company for the last seven years, succeeds James W. Schade, who has been director of research since 1925.

Dean Edward Steidle, of the School of Mineral Industries of the Pennsylvania State College, left by airplane early in January for a visit to South America. He was appointed by Governor James as the representative from Pennsylvania to the first Pan American Congress of Mining Engineering and Geology, which was held at Santiago, Chile, from January 15 to 23. He was also a delegate from the American Institute of Mining and Metallurgical Engineers.

Camille Lherisson, professor of biology at the National School of Medicine, Port-au-Prince, Haiti, has arrived in Washington in response to an invitation of the U. S. Department of State to visit schools of medicine and departments of biology in the United States.

At the New York convention of the Institute of Radio Engineers on January 12, 13 and 14, the principal address was made by Dr. F. B. Jewett, president of the Bell Telephone Laboratories and head of the communications division of the National Defense Research Committee. He spoke on "The Mobilization of Science." The medal of honor of the institute was presented to Dr. A. Hoyt Taylor, superintendent of the Radio Division of the Naval Research Laboratory.

Professor W. D. Cairns, of Oberlin College, gave two lectures on "The Mathematics of Seismology" before the graduate students of Brown University on January 5 and 6.

Austin H. Clark, curator of the division of echinoderms of the U. S. National Museum, delivered an address as retiring president of the Washington Academy of Sciences at the forty-fourth annual meeting of the academy. He spoke on "Science and War."

Dr. H. E. McComb delivered on January 17 the address as retiring president of the Philosophical Society of Washington on "Geophysical Measurements in the Laboratory and Field."

The London *Times* for December 11 prints the following statement: "Sir Patrick Hannon has given notice to ask the Minister of Information in the House of Commons if his attention has been called to the interview given by Professor Julian Huxley on his arrival in the United States of America to isolationist newspapers, in which he has expressed opinions tending seriously to affect the good relations between the United States of America and the British Commonwealth of Nations, and if he will take immediate steps for the recall of this lecturer."

ACCORDING to *Nature*, the Financial Secretary to the British Treasury stated on December 11 in reply to a question in the House of Commons that the number of students at universities and university colleges in Great Britain during the past autumn was approximately 25,000, of whom 5,900 were grouped as taking arts subjects and 19,100 scientific, technical and medical subjects.

AT the autumn meeting of the National Academy of Sciences certain limitations were placed upon the use of the academy building in Washington, in order better to safeguard its defense activities. Since that meeting the United States has entered the war against the Axis powers, and the situation has changed. The executive committee of the council has made the following recommendations to the committee on arrangements for the 1942 annual meeting of the academy: that the meetings be restricted to members alone; that the scientific program be replaced by business meetings at which the functions and relations of the National Academy and of the National Research Council to our Government, during the emergency and afterwards, can be discussed confidentially and at length; that the organization of the academy be considered with reference to most effective operation during war time. Under the proposed arrangements, only members of the academy will be admitted to the sessions; no scientific papers will be read; no public lecture will be given; no formal dinner will be arranged; and no provision will be made for guests at any time, including the informal lunches and the smokers.

A MEETING of the Industrial Research Institute will be held in New York on February 6 and 7. Sixty industrial executives and research directors are expected to attend, and will participate in round-table discussions of research management. Headquarters will be at the Hotel Savoy-Plaza. The sessions will begin on Friday morning with a panel discussion of economic, political and social trends and their possible long-range effects on industrial research policies. There will be a dinner session on Friday evening. Dr. Sumner H. Slichter, professor of business economics, Harvard School of Business, will speak on "The Interrelationships of Labor Problems and Research Problems." On Saturday morning problems involved in adapting industrial research organizations and programs to war-time needs will be discussed.

THE Department of Economics of Columbia University has adopted the following paragraph for insertion in the announcement of the Faculty of Political Science. The department hopes that it will be brought to the attention of students interested in economics at a sufficiently early stage to lead them to acquire at least the mathematical preparation indicated while they are still undergraduates. This is not a requirement, but is advice offered to prospective graduate students in economics; and also that some economic studies make use of mathematics substantially more advanced than calculus and higher algebra. "*Mathematical Preparation:* The use of mathematics, including higher mathematics, has become important in several branches of economics and statistics. Much of the recent important literature of general economics is written in a language not easily understood without some knowledge of the differential and integral calculus. Students planning to work for the Ph.D. degree in economics will therefore find it advantageous to acquire familiarity with the calculus and with higher algebra before beginning their graduate studies in economics."

FOLLOWING a proposal of the Iowa State College Chapter of the American Association of University Professors, the college is instituting a series of "Honor Lectures," to be delivered by members of the staff and published by the Iowa State College Press. The series is designed to examine and emphasize the social philosophy and human significance of science and technology; to provide regular opportunities for the members of the faculty and the graduate student body to learn of recent advances in fields of scholarship other than their own, and to recognize and encourage quality and distinction in teaching and research among the members of the staff. The lecturers will be chosen by a committee of officials of the college, of the chapter of the American Association of University Professors and of other professional societies.

ACCORDING to a cable from Bogota, Colombia, to the *New York Times*, an Institute of Tropical Agriculture is to be established in Colombia to foster the development of the natural resources and productive capacity of the country. Under the agreement by the Colombian Government and the U. S. Department of Agriculture, $5,000,000 is to be allotted to the work.

DISCUSSION

NATURE OF GROUP THEORY

FOR thousands of years the operations of addition and multiplication of ordinary numbers have commonly been regarded as two distinct operations but in group theory, with the exception of zero in multiplication, they are regarded as belonging to the same more general operation. This is due to the fact that in group theory we restrict our attention to what is common to these two operations. In the first place, both of them relate to the combination of elements so as to obtain a single element of the same kind, and the resulting element is independent of how these elements are associated before they are combined. That is, in both of these operations the associative law of combination is satisfied. In fact, the commutative law of combination is also satisfied in both of them but for the sake of greater generality and a comparatively small loss in simplicity this law is not assumed as fundamental in group theory and an essential part thereof.

In 1870 L. Kronecker (1823–1891) read a paper before the Berlin Academy of Sciences in which he remarked that the extremely simple principles upon which Gauss's method is based occur not only at the place to which he had referred but also at many other places and they are used already in the most elementary parts of number theory. This circumstance points to the fact, which can readily be verified, that these principles belong to a sphere of more general and more abstract ideas. Hence it seems desirable to develop them independently of all unrelated matters so that a repetition of the same arguments in their use on different occasions may be avoided. The resulting advantages appear already in the developments themselves, and the presentation thus gains in simplicity and perspicuity by the restriction to what is essential.

These observations were followed by a system of postulates for what is now commonly called an abstract abelian group, but the term group was not then used by him. They illustrate the fact that group theory is not only a subject of mathematics but also an isolation of ideas which are fundamental in various mathematical subjects and a development of these ideas with a view to avoiding repetitions when they present themselves in different subjects. It therefore contributes to the economy of thought and as it relates also to the most elementary subjects of mathematics it may reasonably be expected to be permanently useful. This may account for the recent group theory week at what was then a leading mathematics center of Europe, Göttingen, Germany, and was reported in *Crelle's Journal,* volume 182, pages 129–248 (1940).

The fact which we aim to emphasize here is that abstract group theory was developed before the postulates on which it is based were explicitly formulated so that these postulates resulted from observing basic facts underlying these developments. It is true that after this formulation these developments were greatly extended and gave rise to an autonomous subject of considerable extent which differs widely from the subjects which gave rise to it. Just as the operations of addition and multiplication will probably always be regarded as distinct operations, notwithstanding their union in group theory, so in other fields where the group theory point of view led to interesting broader points of view the original methods have not always become obsolete as a result of these broader views.

Since the term "group" was used in the non-mathematical literature long before it was adopted by the mathematicians as a technical term and its use as such a term grew unusually rapidly in recent years on account of its wide applications, it may not be surprising to find that it is still often misused, especially by popular writers. Some of our best and most recent dictionaries of the English language still fail to give a definition of this term which is in accord with those commonly employed in the modern treatises on the subject. In particular, the associative law is often omitted in the definitions found in these dictionaries. This makes it more desirable to emphasize the nature of group theory as a scientific subject of growing importance, especially in view of the numerous recent misstatements relating thereto by men in positions of great influence.

G. A. MILLER

UNIVERSITY OF ILLINOIS

THE STATUS OF EXPERIMENTAL PSYCHOLOGY AMONG THE LABORATORY SCIENCES

IN order to determine to what extent experimental psychology is being recognized as a laboratory science that will satisfy laboratory requirements toward the A.B. degree, the following questionnaire was sent to 75 of our leading universities and colleges:

1. Does your College of Arts and Science require a minimum number of hours of laboratory science as a prerequisite to the A.B. degree?
2. Is the course in Experimental Psychology recognized as a laboratory science that will satisfy the above prerequisite for a degree?

The replies to this questionnaire indicate three distinct trends in the status of experimental psychology.[1]

The first trend is represented by those institutions that require a laboratory science for the A.B. degree, and that recognize experimental psychology among the laboratory sciences that satisfy the requirement. This group includes the following:

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[1] Data obtained in 1937.

Clark University
College of the City of Detroit
Columbia University
Indiana University
Johns Hopkins University
Leland Stanford University
Ohio University
Oregon State University
State University of New Mexico
University of Georgia
University of Idaho
University of Illinois
University of Minnesota
University of North Carolina
University of Pennsylvania
University of Pittsburgh
University of South Carolina
West Virginia University

The second trend is represented by those institutions that require a certain amount of laboratory science but do not permit experimental psychology to satisfy this requirement. This group includes the following:

Carnegie Institute of Technology
College of the City of New York
Cornell University
Duke University
Emory University
George Peabody College
Georgetown University
George Washington University (D. C.)
Montana State University
New York University
North Dakota University
Northwestern University
Ohio State University
Princeton University
Rutgers College
State University of Nevada
Syracuse University
Toledo University
Tulane University of Louisiana
University of Alabama
University of Arizona
University of Arkansas
University of California (Berkeley)
University of California (L.A.)
University of Chicago
University of Cincinnati
University of Colorado
University of Delaware
University of Florida
University of Kansas
University of Maryland
University of Missouri
University of Nebraska
University of New Hampshire
University of Oklahoma
University of South Dakota
University of Tennessee
University of Texas
University of Vermont
University of Virginia
University of Wisconsin
Vanderbilt University
Washington University
Western Reserve University

The third trend is represented by those institutions that do not require any laboratory work for the A.B. degree. This group includes the following:

Brown University
Duquesne University
Harvard University
Louisiana State University
University of Buffalo
University of Kentucky
University of Louisville
University of Maine
University of Michigan
University of Mississippi
University of Washington
University of Wyoming
Yale University

Summarizing the results of the questionnaire, we gather the following:

62 of the 75 institutions (82 per cent.) require a laboratory science for the A.B. degree.

18 of the institutions (29 per cent.) requiring a laboratory science include experimental psychology among the sciences that will satisfy this prerequisite for a degree.

13 institutions (17 per cent.) do not require any laboratory science for the A.B. degree.

44 institutions (58 per cent.) do not at present permit experimental psychology to satisfy the laboratory requirement for the A.B. degree.

JOHN E. WINTER
WEST VIRGINIA UNIVERSITY

A PLIOCENE WATERHOLE IN WESTERN KANSAS

THIS fall our attention was called to the occurrence of mammal tracks in "Cretaceous chalk" in Graham County, Kansas. Investigation showed an interesting set of footprints which had been exposed by a washout of the spillway from a pasture pond. A thickness of fifteen to twenty feet of sand capped with soil had been washed away, exposing the bedrock with the tracks.

We have found an abundance of the tracks, including camel, rhinoceros, mastodon, one large carnivore track and a number of small tracks as yet unidentified. In places the tracks literally cover considerable areas of the rock.

The matrix enclosing the tracks is a yellowish chalky marl. It grades vertically into less marly chalk of Niobrara Cretaceous. In this, about five feet below the track horizon, one of the boys on the ranch had found fragments of a Cretaceous fish of the genus *Empo*. The rock is covered by a thick layer of almost unconsolidated sand which contains almost no pebbles. In the rock enclosing the tracks and apparently tramped into some of the tracks scattered hard-rock pebbles such as we find abundantly in the "mortar beds" are found. In the over-lying sand the rancher had found a fossil turtle, *Testudo orthopygia*.

The track assemblage indicates a Pliocene age. The rock is a Cretaceous chalk which had been exposed in Pliocene times and had been reworked under water with clay into a marl. The old water-hole floored with this marl preserved a sample of the tracks of at least a few of the types of mammals of that period.

Further study of the tracks and of the rock are being made and will be described at a later date.

GEORGE F. STERNBERG
GEORGE M. ROBERTSON
FORT HAYS KANSAS STATE COLLEGE,
HAYS, KANSAS

THE CASE OF DR. S. LEVINE

JUST to-day I have had an opportunity of reading the article "War Hysteria in Canada," page 461 of SCIENCE, November 14, 1941, and I desire to make a few comments.

At the outset I wish to deprecate very strongly the title of the article. If you were more intimately acquainted with Canadians you would probably realize that they are not given to hysteria.

With regard to the unfortunate experiences of Dr. Levine I may say that his case should be divided into two incidents, namely:

1. His trial, conviction, after an appeal, and his imprisonment on the charge "possession of documents intended or likely to cause disaffection to His Majesty."

2. His internment after release from prison.

Regarding his trial I have followed this case rather closely and have had access to the evidence given in court, and I have no hesitation in saying that, to my mind, there is positively no foundation for the suggestion which appears in this article that there was a "miscarriage of justice." Neither is there anything in the veiled suggestion that Dr. Levine suffered through not having the opportunity of trial by jury. I have just spoken to Dr. Levine's personal lawyer and he informs me that Dr. Levine was not discriminated against in any way as to trial by jury.

Regarding the second item, Dr. Levine's internment, the evidence in the hands of the police, upon which anybody is interned, is not made public. As a matter of routine Dr. Levine's case was reviewed by a commission dealing with several such cases; as a result of the recommendation of this commission Dr. Levine has been recently released.

In the article reference has been made to the evidence of myself and some of my colleagues who appeared on Dr. Levine's behalf at his appeal trial and before the internment commission. As far as I am concerned personally, and I think I may speak for the others, my evidence was in the nature of character evidence and an appraisal of Dr. Levine's academic attainments, together with the suggestion that Dr. Levine would not be dangerous if released. As to the actual facts of the case we were all quite ignorant.

I should also like to make public the position that Dr. Levine occupied at the time of his arrest. After graduating from the University of Toronto B.A. (1932), M.A. (1933), he had held fellowships in different universities in the United States and spent the academic years of 1937–1938 and 1938–1939 at the University of Cambridge, England. During all this time he was pursuing a problem which I first suggested to him the year he graduated at the University of Toronto.

Early in July, 1939, I had letters from two of his Cambridge professors asking me if I could provide for Dr. Levine for the year 1939–1940. In view of the disturbed state just before the war broke out it was realized that the work on which Dr. Levine was engaged could not be continued there. I had to reply that I had no money available to employ Dr. Levine but that I would keep him in mind. Some time in August of that year there came to me from a private donor an offer of $1,500 to pay the salary of a mathematical physicist to undertake some work in the field of geophysics. Although this was not the particular field in which Dr. Levine's work lay, up to that time, I was confident that he would be able to carry out the new work in geophysics and consequently offered to take him on for the year 1939–1940. He began this work about November 1st, 1939. In order that he might be added technically to the Department of Physics, he was given the title of Fellow in Geophysics, but his remuneration did not at any time come from the regular budget of the university. The actual problem on which he was working was completed before his arrest. As he had not completed the full year (12 months) for which the money was provided his employment was continued into the academic year 1940–1941.

It came to me as a bolt from the blue when he was arrested in September, 1940, on the above charge. There is a complete misunderstanding in the suggestion in your article that he has been discharged from the staff of the Department of Physics of the University of Toronto. You will easily understand that his arrest greatly dampened the generosity of the private donor who was providing for his upkeep. As a matter of fact Dr. Levine was paid his salary up to the end of October, 1940—that is, he received the full amount ($1,500.00) donated for a full year's work, although he was arrested early in September.

There is only one other point that I wish to mention. A great deal is made in some of the articles written about this case that Dr. Levine's work in mathematical physics "contributes significantly to the success of the Canadian war effort in the international fight against Fascism." When I appeared on behalf of Dr. Levine when his appeal was being heard I was asked if his work was important for the war effort and my answer was that it might be looked upon as important only so far as all work in geophysics might enable us to discover new materials likely to be useful in the present war. An account of this work has been published in the scientific magazine, *Geophysics*, 6, April, 1941, page 180.

As a matter of fact Dr. Levine has no more moral claim on the University of Toronto than any other of the university's hundreds of graduates. The total number on the staff now working in the Department of Physics is seventy-six, practically all university graduates: of these only nineteen could be considered as having any claim to employment after the current year. Dr. Levine did not at any time belong to the permanent classification.

E. F. BURTON,
Director, McLennan Laboratory

SCIENTIFIC BOOKS

MEDICAL GENETICS

Medical Genetics. By L. H. Snyder. Durham, N. C.: Duke University Press, 130 pp. 1941. $1.50.

A biologist trained in the Harvard School of Genetics, incumbent of the first chair of medical genetics in the land and chairman of the committee of human heredity of the National Research Council has given to the public the lectures that he delivered to the entire body of medical students of Duke University, Wake Forest College and the University of North Carolina with aid from a grant of the Carnegie Corporation. This is well, for as Dr. William C. Davison, of Duke University, says in the foreword, "the knowledge of medical genetics is of practical value in the diagnosis and prognosis of disease and in the everyday practice of medicine."

The book comprises 10 chapters, bibliography and index, and is illustrated. The first chapters consider "The Study of Human Heredity" and "Medico-legal Applications" for which the author is especially prepared by his books, "Principles of Heredity" and "Blood Grouping in Clinical and Legal Medicine." The remaining chapters deal each with inheritance of defects found in a particular group of organs, with susceptibilities and with cancer. At the outset difficulties in the study of human genetics due to small size of families, great length of the generation and varied types of genic behavior and genic expression are referred to; and certain misconceptions regarding geneticists and genetics are listed, such as that geneticists believe that all characters are rigidly determined by heredity, that a character conditioned by heredity can not be altered by environment, that the discovery of a genetical factor for a condition renders further research in that condition futile, that if a causative agent for a disease is discovered heredity factors are excluded, that absence of knowledge of action of the hereditary factor makes "heredity" meaningless. "These are all false."

The body of the text gives examples of what is definitely known about the heredity of certain traits, and here it becomes clear that less is known about certain groups of traits than about others. Thus the genetic basis of abnormalities of the skin, eyes, skeleton and muscles have been satisfactorily worked out in a large number of cases. And this is partly because they are readily observable and diagnosable, so that the family history of the abnormality is fairly complete. On the other hand, the inheritance of mental disorders and diseases of the blood is less fully known.

The book helps open a new era in the study of human genetics by popularizing the recognition of the varied types of heredity transmission—dominant, recessive and blending—as well as the varied relations and behavior of genes, such as autosomal, sex-linked, sex-influenced, lethal, epistatic and combined genes, as seen in multiple allels and multiple factors. "No longer does the familiar 3:1 ratio cover the major portion of the field of heredity." The difficulty of classifying any particular heredity as dominant or recessive is increased by the fact of degrees of dominance. Thus there are degrees of *penetrance* of the dominant gene such that the proportion of affected individuals in a fraternity or generation may depart from expectation. The author recognizes that the differentiation between a dominant gene with low penetrance and a recessive gene is not easy and requires large and unbiased samples and special analytic treatment of them. Again there may be degrees of *expressivity* or degrees of development of the dominant trait even when only a single gene is involved. For example, hemolytic icterus (blood-destroying jaundice) may show symptoms ranging from jaundice and chronic anemia to newly regenerated red blood cells and somewhat enlarged spleen. Again, Von Recklinghausen's disease or neurofibromatosis has a variable expressivity, appearing as cafe-au-lait spots, subcutaneous tumors and plexiform neuroma. This variation in expressivity may be due to environment (*e.g.*, vitamins); but probably constitutional factors play a part perhaps by the varying of the activity of hormones.

Despite all difficulties attempts must be made, and are being made, to work out linkage groups in man's 24 chromosomes. Apart from sex-linked groups little progress has been made. The greatest advance has been secured in the field of "incomplete sex-linkage." To this and results obtained by the new technique Snyder devotes the last and most timely chapter, which constitutes the clearest and fullest statement extant of progress in this field.

While the book is, in general, beyond criticism two points occur to the reviewer as not sufficiently emphasized. One point is that modern pathology seems to be far from appreciating the fact that its categories of disease and defect are shown by genetical studies to be far from unitary. Conditions that are considered under the same name have diverse constitutional organic bases. For example, retinitis pigmentosa and microphthalmus are recessive in some families, dominant in others and sex-linked in still others. Myopia may have either recessive or dominant basis. Of cancers some are stated to depend on dominant, others on recessive factors, and others are affected by multiple or modifying factors.

Finally a point which is not wholly overlooked in this book is, however, insufficiently stressed. It is that those traits that have a known chemical basis have the clearest cut genetics. One of the best illustrations of this conclusion is the blood groups with their agglutinogens and agglutinins. Others are found in the group of the feeble-minded—some types of which are associated with phenylpyruvic acid excretions (recessive trait), some with thyroid deficiency, like cretinism and others with storage of phosphatides like amaurotic family idiocy (a recessive). There is quite an array of inherited errors of metabolism which Garrod emphasized over 30 years ago. Again there is the dopa reaction upon which pigmentation of skin, hair and retina depend. If two or more pairs of genes are actively accelerating melanin formation in the skin the full Negro pigmentation is produced.

The relation between the somatic expression of a trait and its chemical basis may be remote. Thus hardness of hearing seems to depend on a defect in calcium metabolism such as causes abnormal bone formation at the oval window of the inner ear and simultaneously in other parts of the temporal bone. In this latter case there is reason for concluding that the result depends on a dominant factor in an autosome which modifies the reaction of the mesenchyme and a sex-linked gene which perhaps affects calcium metabolism. Indeed it seems probable that in time chemical errors in the body may throw light upon the chemical processes of development.

The fact that so many mutations have a known chemical basis and that development is, indeed, a biochemical process raises the question whether all mutations have not and lead us to seek the chemical basis of any defect. As the chemical bases of mutations are discovered the mutations may well be classified as a chemical basis rather than a morphological. Thus defects in pigmentation might well be grouped together instead of being distributed like albinism under "the eye" and skin color under "the skin." However, we are at present far from knowing these biochemical bases, with minor exceptions, and so for the present the morphological classification employed in part by the author is excusable.

CHAS. B. DAVENPORT

REPORTS

ANNUAL REVIEW OF ACTIVITIES AT FIELD MUSEUM FOR 1941

EXPANSION and improvement of exhibits continued during 1941, as for some years past, to be the major activity of Field Museum of Natural History. Two entirely new halls, one in the department of zoology and one jointly installed by the departments of anthropology and geology, were opened, and many additions were made to the exhibits in other halls throughout all departments.

The year was noteworthy also for an attendance in excess of 1,350,000 visitors; for the continuation of collecting and research by expeditions dispatched to various fields in North, Central and South America, and for the publication on a large scale of the results of these expeditions and other scientific research activities conducted by the staff of the museum.

One of the new exhibition halls is the large new Hall of Fishes, containing elaborate undersea habitat groups, and an extensive series illustrating relationships of the different species. The groups include underwater scenes of the Bahama Islands, the Texas Coast and the shores of Maine. The hall was prepared under the supervision of Alfred C. Weed, curator of fishes; the hundreds of reproductions of fishes were predominantly the work of Staff Taxidermist Leon L. Pray, although other taxidermists and artists also contributed.

The second new hall was H. N. Higinbotham Hall of Gems and Jewels, in which the museum's comprehensive collection of precious stones was reinstalled in a manner that brings out their full beauty of color, luster and brilliance as never before. The most modern museum techniques and equipment were employed, including new types of exhibition cases and improved fluorescent lighting methods.

A unique exhibit was installed in the Hall of Egyptian Archaeology through the courtesy of the General Electric X-Ray Corporation of Chicago, which contributed the x-ray and mechanical equipment. In this exhibit a mummy in its wrappings is shown alternately with the revelation of its skeleton on a fluoroscopic screen. Among many other additions and improvements to the exhibits are included a habitat group showing the inter-tidal algal vegetation of the rocky north Atlantic shore.

Further investigations were made of the prehistoric Mogollon Indian culture in New Mexico by the Field Museum Archeological Expedition to the Southwest. Dr. Paul S. Martin, chief curator of anthropology and leader of the expedition, with associated archeologists, and a "labor force" of twelve for the actual digging, excavated the ruins of an ancient village which had been occupied sometime between 1,200 and 2,400 years ago.

Notable additions to the museum's zoological collections were made by the Leon Mandel Galapagos Expedition. Scientific personnel included Dr. Wilfred H. Osgood, curator of zoology emeritus; Rudyerd Boulton, curator of birds; Loren P. Woods, assistant curator of fishes; Staff Taxidermist Leon L. Walters, and Melvin Traylor, associate in ornithology. Colin C. Sanborn, curator of mammals, sailed to undertake collecting and studies of Peruvian animals.

An expedition which has as one of its objects the determination of the date at which the Isthmus of Panama emerged from the sea was dispatched to Central America in November and will continue its work in 1942. Paul O. McGrew, assistant curator of paleontology, is in charge.

Dr. Sharat K. Roy, curator of geology, collected invertebrate fossils in New York State. Llewelyn Williams, curator of economic botany, sailed in October for a botanical expedition in Venezuela, and will continue collecting and researches for about a year. Donald Collier, assistant curator of ethnology, left in September for five months of archeological research in Ecuador. Dr. Francis Drouet, curator of cryptogamic botany, made an extensive collection of the cryptogamic plants of California. Dr. Fritz Haas, curator of lower invertebrates, collected thousands of representative Pacific shore animals in southern California. A botanical expedition to Guatemala, which began work in 1940, was concluded by Paul C. Standley, curator of the herbarium, and followed by a new expedition to the same country conducted by Dr. Julian A. Steyermark, assistant curator. Emmet R. Blake, assistant curator of birds, and Melvin A. Traylor, Jr., associate in ornithology, carried out a successful ornithological expedition in the southwest. Several specimens of one of the earliest large mammals to walk the earth, the rare *Coryphodon*, and many other fossil animals were collected by a paleontological expedition to the West under Bryan Patterson, assistant curator of paleontology. Mr. Patterson was assisted by James H. Quinn, and others. An important mineral collection was assembled by Bryant Mather, assistant curator of mineralogy, in various eastern states; mammals of the Mount Tancitaro area were collected by Frank C. Wonder on an expedition to Mexico; Mexican insects were obtained by Henry Dybas on a field trip to the Cordoba and Vera Cruz regions; and fossil remains of a ground sloth of the genus *Megalonyx* were collected near London Mills, Illinois, by Assistant Curator Patterson.

Besides the approximately 1,350,000 persons who visited the museum, many additional hundreds of thousands benefited from activities conducted outside of the institution's own building, such as the illustrated lectures and other programs presented by the James Nelson and Anna Louise Raymond Foundation, and the traveling exhibits circulated in the schools by the N. W. Harris Extension.

On May 2, 1941, Field Museum celebrated the twentieth anniversary of its occupation of the present building in Grant Park. Since 1921, more than 25,000,000 persons have entered this structure. More than 5,800,000 others visited the museum during some twenty-five years in its old location in Jackson Park.

For the first time in the history of such institutions as museums in this country, a federal tax on admission charges became effective on October 1. This tax, amounting to three cents each on paid admissions, is now charged to adults, but in the case of children, students, teachers and others to whom the museum is of direct educational importance, the museum itself is paying the cost in order that full benefits to children and to the schools may not be curtailed.

The library of the museum continued to add to its extensive collections of scientific books, which now number approximately 124,000 volumes. A new modernized reading room was prepared for the service of the public.

Boardman Conover and Howard W. Fenton were elected to fill vacancies on the board of trustees. Trustee Albert W. Harris resigned for personal reasons. Two trustees, Brigadier-General Theodore Roosevelt and Ensign Joseph Nash Field, were called to active service in the U. S. armed services. A number of other members of the museum personnel were likewise called into various branches of military service and the museum will hold their positions open for them when they return. Among new appointments to the museum staff were Orr Goodson, assistant to the director; Donald Collier, assistant curator of ethnology; Melvin A. Traylor, Jr., associate in ornithology; Elizabeth Best, guide-lecturer in the Raymond Foundation; and John Janecek, illustrator.

CLIFFORD C. GREGG

SPECIAL ARTICLES

"PEPSITENSIN"—A HYPERTENSINLIKE SUBSTANCE PRODUCED BY PEPTIC DIGESTION OF PROTEINS

CERTAIN findings suggest that the vasoconstrictor and hypertensive substance which originates under the influence of renin is a polypeptid.[1] We were able to show that a vasoconstrictor and hypertensive substance can be produced not only by incubation with renin but also by peptic digestion of hypertensinogen.

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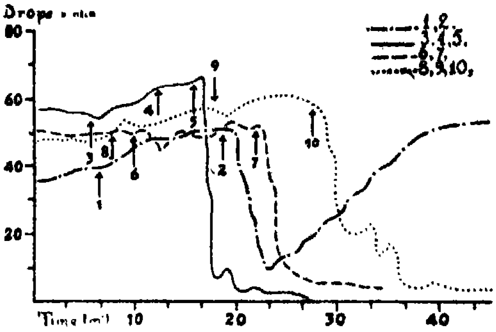
[1] J. M. Muñoz, E. Braun-Menendez, J. C. Fasciolo and L. F. Leloir, *Am. Jour. Med. Sci.*, 200: 608, 1940.

0.5 cc of a standard preparation of hypertensinogen[2] or renin activator[3] in hydrochloric acid (pH = 2 to 6) were incubated at 38° for 15 min. with 1 to 2 mgr of commercial or purified pepsin (Merck) in 0.1 cc of dest. water. A buffer solution of m/5 phosphate of pH = 7.2 was added. A vasoconstrictor effect of great intensity was observed in the Laewen-Trendelenburg preparation of the giant Chilean frog Calyptocephalus Gayi. We obtained also in cats a very remarkable rise of arterial pressure with hypertensinogen incubated with pepsin and conveniently concentrated and purified.[4]

Subsequently we were successful in obtaining a vasoconstrictor substance from different proteins (casein, fibrin, serumalbumin and ovalbumin) incubated with pepsin under conditions identical with those described above for hypertensinogen. The vasoconstrictor effect was always noticeable, though less than with pepsin-incubated hypertensinogen or with hypertensinogen incubated with renin (Fig. 1).

The physiological and chemical properties of the vasoconstrictor substance produced by incubation of proteins with pepsin also resemble those of hypertensin as described by Houssay: the substance is thermostable, soluble in water and strong alcoholic solutions, insoluble in ether, it dialyzes easily through the Cellophane membrane, it is precipitated by phosphotungstic but not by trichloroacetic acid. Trypsin destroys the vasoconstrictor substance produced by pepsin in a similar way as hypertensin is destroyed. Our substance behaved towards hypertensinase[1] also in a way similar to hypertensin: the substance was, like hypertensin, inactivated when mixed with renal extracts (from pig, human, rat) at a neutral pH.

It has been shown by Schroeder[5] with angiotonin (Page) and by our former work[6] with hypertensin that these substances are inactivated by tyrosinase of mushrooms. Likewise we found recently that the vasoconstrictor substance as derived from proteins is destroyed by tyrosinase. This is in favor of the assumption that hypertensin has a phenolic function. Other new findings of ours also are in full agreement with this assumption. Whereas so many proteins when incubated with pepsin generated the vasoconstrictor substance the latter failed to appear when *gelatin* was subjected to incubation with pepsin.



EXPLANATION OF FIGURE

Perfusion of Laewen-Trendelenburg preparation of the giant Chilean frog with Ringer. Ordinates—number of drops per minute. Abscissa—time in minutes. Arrow indicates addition of different solutions. 1. Solution of casein (Hammersten, 3%) for 30 min. in HCl (pH = 5.5); no vasoconstrictor action. 2. Same but incubated with pepsin (Merck-Payr); vasoconstrictor action. 3. Hypertensinogen in HCl; no action. 4. Solution of pepsin (Merck-Payr); no action. 5. Hypertensinogen incubated with pepsin (pH = 4.5); vasoconstrictor action highly pronounced and more stable than in 2 (pepsin-casein). 6. Pepsin in HCl; no action. 7. Hypertensinogen incubated with pepsin (pH = 6); highly pronounced vasoconstriction. 8. Purified gelatin (5%) incubated with pepsin; no action. 9. Same but double quantity added; no action. 10. Hypertensinogen incubated with renin; pronounced vasoconstrictor action.

Conclusions: A substance similar to hypertensin as to physiological, physical and chemical properties can be derived from hypertensinogen by incubation with pepsin. This substance is probably a polypeptid with a phenolic function and it is very likely that this applies also to hypertensin. The term "pepsitensin" seems appropriate for the new substance.

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[2] E. Braun-Menendez, J. C. Fasciolo, L. F. Leloir and J. M. Muñoz, *Soc. Argent. Biol.*, 15: 420, 1939.

[3] K. G. Kohlstaedt, I. H. Page and O. M. Helmer, *Am. Heart Jour.*, 18: 618, 1939.

[4] The method of purification was used as described by Braun-Menendez for hypertensinogen incubated with renin. E. Braun-Menendez, J. C. Fasciolo, L. F. Leloir and J. M. Muñoz, *Jour. of Physiol.*, 98: 283, 1940.

[5] H. Schroeder and N. Adams, *Jour. of Exp. Med.*, 73: 531, 1941.

[6] H. Croxatto and R. Croxatto, *Proc. Soc. Exp. Biol. and Med.*, 48: 392, 1941.

IN VITRO CULTIVATION OF THE STREET VIRUS OF RABIES

SUCCESSFUL *in vitro* cultivation of the virus of rabies has been reported by Kanazawa (1936 and 1937)[1,2] employing a medium consisting of rabbit embryo brain tissue suspended in Tyrode solution, without serum; by Webster and Clow (1936 and 1937)[3,4] in a medium consisting of mouse and chick embryo brain tissue suspended in serum Tyrode; and by Schultz and Williams,[5] who confirmed the latter's work. Kanazawa and Schultz and Williams employed a fixed rabbit strain while Webster and Clow employed three strains originating as follows: one strain from a skunk which was passed through six mouse brain passages, and two dog brain strains passed through eighty-eight and eight mouse brain passages respectively before initiating cultures. Direct *in vitro* cultivation of the street virus of rabies has not been reported.

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[1] Kanazawa, *Jap. Jour. Exp. Med.*, 14: 519, 1936.

[2] Kanazawa, *Jap. Jour. Exp. Med.*, 15: 17, 1937.

The source of our infectious material was obtained as follows: About three months after a young man was bitten by a stray dog on the ring finger of his left hand, he developed symptoms of rabies and died in a typical attack. Examination of the brain showed Negri bodies. The brain was preserved in 50 per cent. glycerine. (This will be designated as strain A.)

The second strain was obtained from a rabid dog which was killed after paralysis developed. Examination of this brain showed Negri bodies. The brain was preserved in 50 per cent. glycerine. (This will be designated as strain B.)

Each brain specimen was treated as follows: Several pieces of brain were washed four times in Ringer's solution to remove the glycerine and then the material was ground in a mortar with alundum. A 10 per cent. aqueous suspension was made and centrifuged at 1,200 r.p.m. for ten minutes. The supernatant fluid was titrated for infectivity by inoculating serial dilutions—0.03 cc intracerebrally—into mice, and the rest of the supernatant fluid was employed for culture. The infectivity of strain A was 10^{-3}, killing mice after 14 days and Negri bodies were demonstrated in the brain (Sellard's stain).

Strain B was infectious in a dilution of 10^{-2}, killing mice in 9 to 12 days, with the presence of Negri bodies in the brain.

The medium employed for culture was essentially the same as has previously been described[6,7,8,9] for the cultivation of the virus of fowl plague, vaccinia and measles. Three cc of Tyrode solution and 0.5 cc of unfiltered monkey serum was placed in a 50 cc Erlenmeyer flask. To this was added four drops of a ten-day chick embryo cell suspension prepared with the Fisher press, and 1 cc of virus material and three drops of chicken plasma. The contents of the flask were gently shaken and stoppered with a rubber stopper. Cultures were maintained at 37° C. for three to four days.

After twenty-four hours the plasma clot was found floating on the surface of the liquid medium. Sections made of the clot show proliferating cells, in contrast to the non-proliferating cells which exist in a suspended cell medium. One of us[6,7] had previously shown that the virus of fowl plague and the virus of vaccinia grow much better in the presence of proliferating cells than they do in the presence of suspended cells. The experiments of Feller, Enders and Weller[10] bear on this observation.

Transplants are made by grinding the entire culture in a grinder with alundum and transferring 1 cc of the supernatant material to a new flask of media. Strain A was maintained through eleven transplants while Strain B was maintained through nine transplants.

During the course of these experiments, various transplants were inoculated intracerebrally into mice to determine the presence of virus. With strain A, mice died in from seven to eleven days, showing the presence of Negri bodies in the brain. The brain of a mouse that died after the inoculation with the eighth transplant (strain A) was titrated for infectivity. A dilution of 10^{-5} killed mice in eight days and the brains were Negri positive.

Titration of the clot of the eleventh transplant (strain A) killed mice in a dilution of 10^{-6} in eight and eleven days, but no Negri bodies were found. In a dilution of 10^{-5}, mice died in nine and eleven days and Negri bodies were demonstrated in the brains. The mice that died after inoculation with the lower dilutions were also Negri positive.

Titrations of the clot of strain B killed mice in twelve days in a dilution of 10^{-5} and the brains were Negri positive. Other mice inoculated with this dilution showed tremors on the thirteenth day and Negri bodies were demonstrated in the brain. Mice inoculated with lower dilutions, that died or were sacrificed when tremors were present, also showed Negri bodies in the brain. While strain B was infectious for mice in a dilution of 10^{-5}, this strain was not as virulent for mice as strain A.

We failed to cultivate the virus from another dog brain.

The street virus of rabies has been cultivated directly from the brain of a human case of rabies as well as from the brain of a rabid dog. The virus has been successfully cultivated through eleven and nine transplants respectively. The method of culture employed consists of whole chick embryo tissue instead of embryo brain tissue alone, as has hitherto been

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[3] Webster and Clow, SCIENCE, 84: 487, 1936.

[4] Webster and Clow, *Jour. Exp. Med.*, 66: 125, 1937.

[5] Schultz and Williams, *Proc. Soc. Exp. Biol. and Med.*, 37: 372, 1937.

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[9] Plotz, Third International Congress of Microbiology, Report of Proceedings, p. 358, 1940.

[10] Feller, Enders and Weller, *Jour. Exp. Med.*, 72: 367, 1940.

used. The "floating clot" method has the advantage of providing a large mass of proliferating cells, which provide a great yield of virus. In view of this, experiments are being performed to determine whether these cultures can be employed as a vaccine.

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MECHANISM OF P-AMINOBENZOIC ACID ACTION AND THE PARALLEL EFFECTS OF ETHYL CARBAMATE (URETHANE)*

IN seeking a theoretical basis for the bacteriostatic effects of sulfanilamide, Woods and Fildes[1,2] first postulated that the drug competed with a structurally related molecule, para aminobenzoic acid (PAB), which was thereby presumed to occupy some essential rôle in the normal growth and metabolism of micro-organisms. The latter compound thus has a dual interest: as a possible intermediary in ordinary metabolism and as a possible site of sulfanilamide inhibitions. Numerous investigations seem to have provided evidence supporting both aspects of the original hypothesis, and to have greatly extended the biological significance of PAB.

It now appears widely accepted that PAB is not only a naturally occurring "essential metabolite,"[3] but an anti-sulfanilamide or a growth factor for diverse organisms, including chicks,[4] dermatophytes[5] and even autotrophic plants, *e.g.*, diatoms.[6] The same compound is thought to be concerned in lactation[7] and in pigmentation of hair.[4] Its anti-sulfanilamide effects on the growth of bacteria have been demonstrated *in vivo*[8] as well as *in vitro*.[1] Doubt has been expressed, however, that this anti-sulfanilamide effect is in the nature of a competitive action of the two molecules for the same receptor in the organism, since 1 molecule of PAB may antagonize 23,000 molecules of sulfanilamide. Before the above-mentioned interpretations become too deeply entrenched in the scientific literature and thought as fully correct, an alternative explanation for the mode of sulfanilamide action, as well as the stimulatory effects of PAB, should be considered.

Recent experiments in this laboratory have shown that *ethyl carbamate (urethane) as well as PAB may exert anti-sulfanilamide effects* on luminous bacteria. The results are more striking in relation to luminescence than to growth, although both are influenced. The structural similarities between the molecules of urethane and sulfanilamide are so remote as to rule out competitive action, and urethane could hardly be considered an "essential metabolite." It is a familiar principle, however, that narcotics and, indeed, poisons of many sorts, have stimulatory effects in low, and inhibitory effects in high concentration. All three of the above compounds—urethane, PAB and sulfanilamide—act in the manner of narcotics on luminous bacteria, stimulating growth and luminescence in low, while inhibiting in high concentrations.

Further evidence of the fundamentally narcotic action of PAB, sulfanilamide and urethane, quite apart from growing cultures, is found in their effects on washed cell suspensions. The intensity of luminescence is readily and reversibly reduced on the addition of any one of these or a host of other narcotics. Experiments with the luminescent luciferin-luciferase system, which can not be extracted yet from bacteria but can be obtained in purified preparations from *Cypridina*[9] have shown that the velocity constant of the reaction *in vitro* is retarded by urethane, PAB, sulfanilamide, sulfapyridine and sulfathiazol. The action is reversible and clearly on the enzyme, luciferase. Over a wide range it is independent of the substrate (luciferin) concentration.[10] Thus, the inhibitory effects of PAB, urethane and sulfonamides appear to be definitely related to those of narcotics in general. Recent work with hydrostatic pressure and temperature[11] has opened a new approach to the study of the basic mechanism involved.

The stimulatory action of narcotics in low concentration is not easy to explain. In the present connection, the point to be emphasized is that the stimulatory effects of one narcotic may antagonize or completely overcome the inhibitory effects of another that is simultaneously present. If the inhibitant is sulfanilamide, the antagonist is naturally looked upon as "anti-sulfanilamide." The anti-sulfanilamide action of both urethane and PAB might well belong in this category. The molecular structure of the antagonistic narcotics need not be closely related, as would be required for competitive inhibition in the physicochemical sense. The action of urethane and of nembutal in preventing death from sulfonamide overdosage of animals[12] lends support to the view ex-

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* The studies in this laboratory have been aided, in part, by a grant from the Penrose Fund of the American Philosophical Society.

[1] D. D. Woods and P. Fildes, *Chem. Ind.*, 59: 133, 1940.

[2] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74–90, 1940.

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[11] F. H. Johnson, D. E. S. Brown and D. A. Marsland, to be published in the near future.

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pressed above, although its possible significance in relation to the mechanism of sulfanilamide and PAB effects has apparently been overlooked. Other examples of antagonisms among narcotics could be cited. The whole problem needs further study.

In summary, both the stimulatory and inhibitory effects of PAB and sulfanilamide, as well as urethane, appear to be fundamentally related to the general problem of narcotic action, which does not necessarily involve a structural similarity between the molecules of the inhibitor and an intermediary of normal metabolism in the cell. This interpretation has some interesting implications with respect to the various effects of PAB in different organisms referred to above. Further study from the point of view discussed would appear justified on the basis of the evidence at hand.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A HEAD HOLDER FOR INTRACRANIAL OPERATIONS ON THE MONKEY

THE advantages of fixation of the head, apparent to any one undertaking intracranial operative procedures in experimental animals, are readily secured in carnivores by use of the Czermak type head holder. Adaptation of the Czermak holder for employment with monkeys has not proved satisfactory in our hands, and we have thought it worth while briefly to describe the apparatus devised for that purpose in this laboratory.

The essential instrument is the head holder (A) invented some years ago by Dr. A. R. Buchanan for use with the Horsley-Clarke machine on guinea pigs (Fig. 1). This consists of a cylindrical cross-bar (1) and two side arms (2) which slide onto the bar and can be tightened in place by set screws (3). The cross-bar is slotted and an interlocking piece fitted on the interior of the base of each arm, in order that the arms be aligned in the same plane. When employed with the stereotaxic instrument on the guinea pig, the Buchanan holder is applied by approximating the two arms until the shaped pins (4) fit into the meatuses. Finally the ear bars of the Horsley-Clarke machine are seated in the openings (5). When the Buchanan holder is used to fix a monkey's head, the ear plugs (D) are firmly inserted into the meatuses; these are the short, straight plugs described by Harrison.[1] The side arms are then approximated until the shaped pins are solidly set in the open ends of the ear plugs, and the arms held in place by tightening the set screws. Dorso-ventral rotation of the animal's head is prevented by introducing into the opened mouth a straight bar covered with rubber tubing (E), and making this fast on the side arms by the use of two common right angle clamps (C), as illustrated in the lower figure.

As shown by the sketch of the apparatus set up for operation, the Buchanan holder can be attached to a vertical bar (F), arising from the table, and adjusted to a convenient height by any suitable clamp. We have employed a universal clamp (G) to allow tilting to either side. For approaches through the convexity of the calvarium no further fixation of the head is needed. In lateral approaches involving exposures down to the zygoma, the distal part of the side arm forms an inconvenient bulge beneath the drapes. This might be obviated by constructing a side arm containing a right angle or one made so that it would lie flush with the ear.

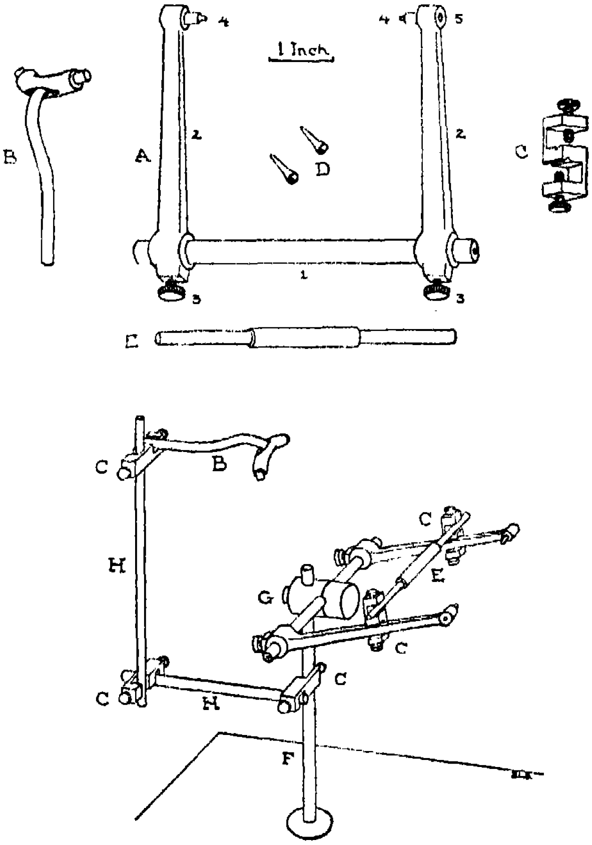

FIG. 1.

For approach to the posterior fossa through the enlarged foramen magnum, we have found it necessary further to stabilize the head to prevent its dorsiflexion. For this purpose a simple nose piece (B) was contrived, the cross-bar of which, covered with rubber tubing, fits across the nose immediately below the eyes. As demonstrated in the figure, the nose piece can be mounted from the vertical rod (F) by means of two straight bars (H) and three right angle clamps (C). For the posterior approach the Buchanan holder is turned in the universal clamp until the side arms of the holder are almost vertical, in order to obtain proper exposure of the operative site. The nose piece (B) can then be adjusted.

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[1] F. Harrison, *Arch. Neurol. Psychiat.*, 40: 563, 1938.

The Buchanan holder in the size shown accommodates monkeys weighing up to 4 kilograms and, used without ear plugs, is also satisfactory for guinea pigs. In neither the monkey nor the guinea pig does the apparatus rupture the tympanic membrane or do apparent injury to the external ear.

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SODIUM DIPHENYLHYDANTOINATE AND EXPERIMENTAL EPILEPSY

Sodium diphenylhydantoinate is a drug introduced by Putnam and Merritt in clinical practice for treatment of epileptic seizures on account of their particularly efficient anti-convulsant action with the least hypnotic effect. Primarily such results were obtained on cats with convulsions induced by electrical stimulation of the cerebral cortex.[1] Clinical investigations were performed later.[2]

In this article are discussed experiments performed in our laboratory with sodium diphenylhydantoinate in an experimental epileptiform seizure of the frog induced by quick cooling of the spinal cord. The results reported are a résumé of a more detailed paper in preparation.[3] The technic employed was recently reported[4,5] and now is usual in our laboratory. For the Brazilian frog (*L. ocellatus*) cooling of the isolated spinal cord of the preparation to a temperature below 8° C. produces an epileptiform seizure which lasts 20 to 40 seconds. For the American and European frog the cooling must be below 0° C.

The anti-convulsant action has been studied injecting sodium diphenylhydantoinate solution in the abdominal lymphatic sac before the isolated spinal cord preparations were started. The doses employed varied from 0.05–0.90 grams per kilogram of body weight. Doses from 0.05–0.09 grams did not avoid the production of the attacks, but sometimes they were less severe. Doses greater than 0.10 grams per kilogram commence to hinder the production of the convulsions and 0.15 grams prevent the epileptiform seizure in nearly all the frogs injected. This anti-convulsant effect was observed with no hypnotic effect, the frog jumping quite well in the laboratory. When the medulla was sectioned and the isolated spinal cord prepared, the flexor reflexes of the legs were as in the normal preparations. Such anti-convulsant action is still observed after 2 days elapse between the injection of the sodium diphenylhydantoinate and the cooling of the spinal cord. Hypnotic effects were obtained only with doses superior to 0.20 grams per kilogram. The lethal dose has not been determined, being superior to 0.90 grams.

Sodium diphenylhydantoinate acts on the spinal cord of the frog, hindering the epileptiform seizures induced by quick cooling with no hypnotic effects and disturbances of the spinal reflexes.

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IMMUNITY IN VIRUS INFECTIONS[1]

By THOMAS M. RIVERS, M.D.

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For many years it has been recognized that one attack of certain diseases, now classified as virus maladies, induces an enduring immunity. Because of this fact and since many workers believed that viruses are radically different from other types of infectious agents, there arose in some quarters the idea that immunological and serological phenomena in the virus field differ from those in other fields of infection. This was an erroneous idea because the basic principles underlying serological and immunological phenomena in all fields of biology are identical. These principles, however, may evidence themselves in different manners in the various fields, and the techniques of studying the phenomena associated with them in different fields frequently vary because of the nature and mode of action of the infecting agents. It will be impossible to discuss at this time all the different phenomena and peculiarities associated with immunity in the numerous virus diseases. Therefore, a few general remarks will be made, following which immunological and serological phenomena associated with vaccinia will be discussed in detail.

Immunity is resistance to infection or injury and is demonstrable only in a living host. Such resistance may be natural or acquired. The acquired form may be associated with certain serological phenomena, for example, complement fixation, agglutination, precipitation and neutralization. It must be remembered, however, that these phenomena, while interesting, may not be directly responsible for the immune state of a host.

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[1] Delivered on September 26, 1941, as part of a symposium on immunity at the Fiftieth Anniversary Celebration of the University of Chicago.

One of the most striking immunological phenomena in the virus field is the complete and enduring immunity that follows many of the diseases in this category. It is so striking that there was a tendency at one time to make generalizations to the effect that all virus diseases are followed by a lasting immunity. Now we know that this is not true. While smallpox, chicken pox, measles and yellow fever are followed by a protracted immunity, other virus diseases, *e.g.*, influenza and common colds, produce protection of short duration. An awareness of the difference in the duration of immunity following different virus diseases immediately raises the question as to why some of them induce a lasting immunity and others do not. Many workers in this field believe that a life-long immunity to a second attack of a virus disease is due to a persistence of the virus in the recovered host. Inasmuch as circulating antibodies against yellow fever virus have been found in a recovered host for as long as fifty years after an attack of the disease during which time no further contact with the active agent has occurred, the statement just made about persistence of virus is particularly applicable to yellow fever. Such a persistence does not mean that an immune individual is capable of spreading disease, because it is most likely that the virus is stored in some remote part of the body within living cells where it can not come in contact with circulating antibodies and from which point it can not, for one reason or another, reach the outside world.

A statement to the effect that an infectious agent can persist for so long a time in a host in the presence of neutralizing antibodies seems to shock some workers. There is nothing strange about the situation if one realizes that viruses multiply and carry on all their activities within living cells. Furthermore, while situated intracellularly the active agents can not be attacked by antibodies. Consequently, if a virus and its host cells multiply at approximately the same rate and if the host cells are not destroyed by the virus, the two can live together happily year after year without the infecting agent ever being subjected to the action of humoral antibodies. There is ample experimental evidence to show that such a state of affairs can and does exist under certain conditions.

Thus, following certain virus diseases the prolonged or enduring immunity is probably due to a long-term sojourn of the virus in the host or its persistence throughout the host's life. From such a statement one might infer that the reason for the absence of an enduring immunity following attacks of certain virus diseases is due to the fact that the inciting agents of these maladies are not capable of permanently establishing themselves in an infected host or that they do not persist long enough in a host to bring about a profound immunity. Why the virus can not permanently establish itself in some diseases is not known. Perhaps the type of tissues involved is responsible. For example, it is possible that in the case of the common cold and influenza the viruses attack superficial tissues, establish themselves in such tissues and would lead to an enduring immunity if these tissues were not themselves temporary. In other words, the superficial cells lining the respiratory tract are being thrown off at regular intervals to be replaced by new cells from deeper layers and do not provide a permanent abode for viruses.

This explanation for the persistence and lack of persistence of immunity to certain virus diseases may not cover the field completely, and doubtless some workers will object to it. On the other hand, there are good reasons for believing that the conditions described play a part in the picture. In any event, it is well known that a plant once infected with a virus, although it may later assume a fairly normal appearance, still carries the virus and is refractory to reinfection. Moreover, Kunkel has shown that one virus disease of plants can be cured by treatment at a temperature which inactivates the virus without injury to the plants and that the cured plants return to a state of susceptibility to infection.

What has been said about the persistence of immunity following attacks of virus diseases has a bearing on the production of immunity by means of vaccines. At the beginning of the virus era it was not unusual to hear that a protection could not be induced except by the use of vaccines containing active viruses. While it is true that immunity against many virus diseases has not been induced except by the use of active agents, it has been possible in the case of others, *e.g.*, equine encephalomyelitis, rabies and influenza, to produce an appreciable amount of protection by means of inactive agents, provided sufficient quantities of them are used. If enduring immunity is due to persistence of virus in a host, then one would not expect inactive viruses to produce a prolonged immunity because of their inability to establish themselves and continue to multiply. This appears to be the case, because whenever inactive viruses are used it is recommended that vaccinations be repeated at stated intervals.

The fact that viruses multiply within living susceptible cells and can not be attacked by antibodies while within such cells has a bearing on serotherapy of virus diseases. It is generally believed that once a virus has invaded a host and has manifested itself by signs and symptoms of illness, it is too late to modify materially the course of the disease by the therapeutic administration of immune serum. This belief has arisen as the result of many negative reports regarding the value of immune serum in the treatment of virus maladies. If the belief is justified, and it undoubtedly is in the case of many virus diseases, one has to seek for an adequate explanation of such findings further than the fact that viruses multiply in cells and can not be attacked by antibodies while so situated. In order to account completely for the negative findings regarding serum therapy, it is necessary to assume that all the cells that are going to be infected in a particular host by a virus have been infected by the time signs and symptoms of illness become evident. This assumption is substantiated by a considerable amount of experimental work. Fite and Webster have shown that after instillation of louping ill virus in the noses of mice the active agent is present in the brain four days before the animals evidence signs and symptoms of illness. Galloway and Perdrau found that after instillation of louping ill virus in the noses of monkeys the active agent was well distributed throughout the central nervous system several days before the animals showed signs of sickness. Hurst instilled equine encephalomyelitis virus into the noses of monkeys, sacrificed them at different times after inoculation, tested various parts of their central nervous systems for the presence of virus, and correlated his findings with clinical observations made on the monkeys before they were killed. According to him, all parts of the central nervous system except the cord contained virus within thirty hours after onset of fever, and several hours later, at the time of onset of nervous symptoms, even the lumbar cord was infectious. Webster and Clow dropped the virus of the St. Louis type of encephalitis into the noses of mice, sacrificed some at different times in order to test for the presence of virus in various parts of the brain and cord, killed others to determine the time of appearance and progression of lesions, and allowed others to sicken and die in order to determine the time of onset of clinical signs and symptoms. The data obtained in this manner clearly showed that virus was present in tissues twenty-four to forty-eight hours before the appearance of lesions detectable by means of the microscope and that all parts of the brain and cord contained large amounts of virus before the animals became ill. Faber and Gebhardt conducted similar experiments with monkeys that had been infected by means of intranasal instillation of poliomyelitis virus. Their findings indicated that by the fifth, sixth or seventh day after inoculation, at which time only an occasional rise of temperature or tremor and hyperesthesia were present, and before paralysis had occurred, virus was distributed throughout the central nervous system.

Following the general remarks about immunity in virus diseases, it seems advisable to discuss in detail certain immunological and serological phenomena associated with vaccinia. It is generally accepted that a successful vaccination against smallpox in which active vaccine virus is used results in a satisfactory immunity which endures for a varying period of time, *i.e.*, from several years to a lifetime. Many attempts have been made to obtain satisfactory immunity both in lower animals and in human beings by means of inactive vaccine virus.While a low-grade protection can be obtained in this manner in lower animals, provided large amounts of inactivated vaccine virus are used, no definite evidence as yet has been brought to indicate that any of the inactivated vaccines employed are of real value in the protection of human beings against smallpox.

In some virus diseases, the only humoral antibody that has been demonstrated is one which neutralizes the inciting agents, as is the case in poliomyelitis. In other virus diseases, for example, in Shope's papilloma of rabbits, complement-fixing and neutralizing antibodies have been demonstrated, and apparently they are identical, reacting to a single antigen, the virus, in different ways under different conditions. In still other virus diseases, for example, in infectious myxomatosis of rabbits and vaccinia, there appears to be a multiplicity of antigens and antibodies. In fact, the serological studies of vaccinia and infectious myxomatosis of rabbits have gradually made it obvious that many of the phenomena observed in other types of infectious diseases are also observed in the virus field. Moreover, methods used for investigating these phenomena in the virus field are in many instances identical with or similar to those employed in other biological fields.

Sternberg in 1892 demonstrated that the serum of an animal recovered from vaccinia possesses the property of neutralizing the activity of the virus. In 1899 Béclère, Chambon and Ménard confirmed and extended Sternberg's observations. In addition to this, they showed that sera of human beings and monkeys convalescent from variola possess neutralizing antibodies for vaccine virus. The first definite demonstration that flocculation occurs in a mixture of vaccinia-immune serum and vaccine virus was made in 1904 by Freyer. In 1906 Jobling demonstrated that complement is fixed in the presence of a mixture of vaccine virus and serum from calves convalescent from vaccinia. Paschen reported in 1913 that elementary bodies of vaccinia are specifically agglutinated by vaccinia-immune serum.

In 1925 Gordon in a Medical Research Council Report presented the results of his extensive study of the antibodies found in vaccinia- and variola-immune sera. He again took up the question of complement fixation and definitely showed that the viruses of vaccinia and variola specifically fix complement in the presence of homologous antisera. He also showed that vaccine virus fixes complement in the presence of variola-immune serum and *vice versa*—phenomena indicating the antigenic similarity or identity of the viruses. This work has been fully confirmed by Parker and Muckenfuss and by Craigie and Wishart. Furthermore, Gordon found that a flocculation occurs in mixtures of vaccinia-immune serum and vaccine virus, and showed that the reaction is specific in that vaccinia-immune serum flocculates only in the presence of vaccine virus or smallpox virus. He spoke of the reaction as an agglutination; but as will be pointed out presently this was a mistake, because the flocculation was undoubtedly due to two phenomena, *viz.*, a precipitation of soluble substances and an agglutination of elementary bodies. Indeed, some of the tabulated results of his experiments should have indicated to him that a soluble substance separable from the virus was playing a part in the complement-fixation reactions as well as in the flocculation tests.

In 1929 Burgess, Craigie and Tulloch described in a Medical Research Council Report the results of their work on the vaccinia-variola flocculation test in which they were able to confirm most of Gordon's observations. In 1931 another report by Craigie and Tulloch on the same matter extended their previous observations. Ledingham, in 1932, using specially prepared elementary bodies of vaccinia, showed by means of the hanging drop method a specific agglutination of the bodies in the presence of vaccinia-immune serum. In 1932 Tulloch reported that in ordinary preparations of vaccine virus there is present a soluble fraction, separable from the virus itself, which gives a precipitin reaction when mixed with immune serum. Shortly after this report, Craigie confirmed Tulloch's observation and stated that the flocculation test described by Gordon with crude virus suspensions involved both a precipitin and an agglutination reaction, the precipitin reaction being caused by a soluble substance separable from the virus, while the agglutination reaction represented an aggregation of elementary bodies. In 1934 Craigie and Wishart reported that the soluble fraction is made up of two components; one, designated as L, is labile and no longer active after being heated at 56° C; the other, called S, is stable at 95° C. Craigie and Wishart later stated that L and S are probably not separate entities but form an LS complex. Inasmuch as the stable substance gives a Molisch reaction, Craigie, Smith and Ch'en at one time believed it to be a polysaccharide derived from the virus. Parker and I have confirmed most of Craigie's observations, but do not agree with him that the stable substance (S) is a polysaccharide; it is a protein with particular properties. Moreover, Parker later showed that under certain conditions L and S are separable and are not always united in an LS complex. Recently, in 1938, Craigie and Wishart stated that they now believe the LS complex to be capable upon storage of breaking up into its separate components L and S.

At this stage of our knowledge there appeared to be in vaccinia-immune serum antibodies capable of doing the following things: neutralize virus; agglutinate elementary bodies; fix complement; and precipitate specific substances which had been separated from the virus. The agglutination of elementary bodies may take place because of the reaction between the soluble substances, L and S, adsorbed on their surfaces, and the L and S antibodies. On the other hand, Craigie believes that there is in addition to the L and S substances adsorbed on elementary bodies, another agglutinogen, X, which gives rise to X agglutinins. The antibodies that fix complement and produce the precipitin and agglutination reactions are likely to be the same, merely exhibiting their activity in different ways when they cause agglutination, complement fixation and precipitation. There is reason to believe that neutralizing antibodies are different from the others, because, as Parker has shown, an animal immunized with purified S is not immune to vaccine virus nor does its serum neutralize more than a minimal amount of virus in spite of the fact that it causes the other reactions that S antibodies should. Moreover, it is easy by adsorption to remove from vaccinia-immune serum L and S antibodies and with some difficulty the agglutinins also without diminishing the neutralizing titer of the serum.

Several years ago Dr. Smadel and I undertook further investigations of the LS complex spoken of by Craigie. In addition to this, we also endeavored to obtain more information regarding the existence of unrecognized antigens in vaccine virus. The first thing we did was to extract washed elementary bodies of vaccinia with N/20 NaOH at 56° C. for a short time and then quickly neutralize the material. This extraction yielded a nucleoprotein which gave a precipitin reaction with unadsorbed vaccinia-immune serum. Such a serum from which all the L and S antibodies had been removed by adsorption still possessed its full ability to precipitate in the presence of the nucleoprotein antigen extracted from the elementary bodies. Inasmuch as Smadel, Dubos and Lavin have shown that S is not a nucleoprotein and in view of the results of adsorption just described, it is obvious that S and the nucleoprotein extracted from elementary bodies are distinct antigenic entities.

We next investigated the relation of the nucleoprotein antigen to Craigie's X agglutinogen and an antigen which produces neutralizing antibodies. According to Craigie, the X agglutinins are the antibodies left in a vaccinia-immune serum following adsorption with L and S. Such a serum adsorbed with the nucleoprotein antigen removed some of Craigie's X agglutinins but not all of them. Consequently, we believe that Craigie's X agglutinins are produced as a reaction in part to the nucleoprotein extractable from elementary bodies and in part to some other antigen or antigens of the virus. In other words, Craigie's X agglutinogen is not a single substance. Serum adsorbed to remove all L and S and all nucleoprotein antibodies still possesses full neutralizing value. Thus, it is obvious that the extractable nucleoprotein antigen is not responsible for the production of neutralizing antibodies.

By the proper means L or S antiserum can be obtained. When either of these sera is mixed with a fresh filtrate from the skin of a rabbit infected with vaccine virus, both L and S are removed. Because of this fact Craigie stated that the two substances L and S probably do not occur separately but as an LS complex. On one occasion, however, Parker obtained a dermal filtrate in which he thought that L and S occurred separately in that one could be removed completely without the entire removal of the other component. Craigie also was able on one occasion to confirm this finding of Parker. Nevertheless, the original findings of Craigie are the ones usually encountered. Inasmuch as questions about the identity of L and S were still open, Dr. Smadel and I for several years have been pursuing the matter.

Fresh virus-free filtrate from vaccinia-infected skin of rabbits contains both L and S. When heated at 56° C., L no longer is precipitated in the presence of its antiserum; however, it inhibits L antibodies so that when unheated L is added to the mixture no precipitate occurs. When heated dermal filtrate is treated with dilute alkali and heat for a short time and then neutralized, it neither inhibits L antibodies nor does it precipitate in the presence of S antibodies; but a filtrate treated in such a manner inhibits S antibodies. If the filtrate is degraded further, it no longer inhibits S antibodies. Moreover, purified S, obtained according to the method of Parker and Rivers, was found to inhibit L antibodies while still capable of precipitating with S antibodies. After the purified S was treated with dilute alkali and heat and then neutralized, it no longer inhibited L antibodies, did not precipitate in the presence of S antibodies, but did inhibit S antibodies. From these findings it was concluded that LS is probably a single substance with two reactive components, L and S, which are degraded with different degrees of ease. At that time we were aware of the fact that definite proof of this idea of the nature of L and S was lacking and that such a conception was directly opposed to the occasional findings of Parker and Craigie in which L and S apparently were separated from each other by means of adsorption.

Believing that some of the newer techniques might be of assistance in purifying the LS complex and acquiring further information regarding its nature, Shedlovsky and Smadel attempted by means of the Tiselius apparatus to obtain LS in pure form from a filtrate of dermal pulp. They soon found that it would not be possible to obtain pure LS by this means alone. Then they used a combination of methods, fractionation by means of precipitation and by electrophoresis. When the dermal filtrate was brought to a pH of 4.5, a precipitate formed which was partially soluble at pH 6.5. If this procedure was carried out properly, it was found that the material which went back in solution at pH 6.5 possessed the nature of a globulin and gave evidence of being a single substance both in the ultracentrifuge and in the Tiselius apparatus. Moreover, this substance reacted equally well with L and S antibodies. When heated at 56° C. it inhibited L antibodies but still precipitated with S antibodies. When treated with dilute alkali and heat and then neutralized, it did not inhibit L antibodies, did not precipitate with S antibodies, but did inhibit S antibodies. As a result of this work it seems obvious that L and S are components of a single substance.

The data just presented regarding L and S are believed to be correct and their meaning is obvious, but they do not contain an explanation of the occasional findings of Parker and Craigie in which L and S were apparently different substances. These men are excellent investigators and it is not reasonable to believe that their observations were false. Therefore, some explanation for their occasional findings was sought. A hypothesis was formed to the effect that L and S is one substance with two serologically reactive components and that under usual conditions the activity of L is more easily suppressed than that of S. On the other hand, it was believed that it might be possible for events to occur the other way around under exceptional conditions, as for instance in the presence of special enzymes. Consequently, Smadel and Hoagland tested the effect of certain crystalline enzymes on the activity of purified LS. Very quickly it was shown that crystalline chymotrypsin acting on pure LS destroys the activity of S, leaving that of L unimpaired. With these findings all the parts of the puzzle, L and S of vaccinia, seemed to fall in place, and now more than ever it seems reasonable to conclude that they are nothing more than different components of a single protein molecule.

Little or nothing is known about the antigen that gives rise to antibodies that neutralize the virus of vaccinia. Indeed, most workers have been unable to remove these antibodies from immune serum by means of adsorption with purified elementary bodies. On the other hand, Salaman believes that there is a union between elementary bodies of vaccinia and neutralizing antibodies and that if sufficient amounts of elementary bodies are used the neutralizing substances can be adsorbed from immune serum. An assessment of information regarding the antigen that incites the production of neutralizing antibodies and the manner in which such antibodies act reveals that much remains to be learned concerning this the most important of all subjects connected with immunity to vaccinia.

From my remarks regarding viruses in general and vaccine virus in particular, it should be evident that there is nothing peculiar about immunity in virus diseases. Principles that hold in other fields operate also in the virus domain. Furthermore, it should be obvious that generalizations about immunity in virus maladies can be made with no more assurance than about resistance to other types of infection. Immunological and serological phenomena in each virus disease present special problems that have to be met not through generalizations but by specific experiments.

NORMS OF GROWTH

By Professor EDWIN B. WILSON

DEPARTMENT OF VITAL STATISTICS, HARVARD SCHOOL OF PUBLIC HEALTH

In the *Proceedings* of the National Academy of Sciences (Vol. 21, pp. 633-4, 1935) I gave average heights and weights of 275 school girls for consecutive ages 7 to 16 years inclusive with the correlations of the heights and of the weights in the different years based on the measurements obtained in Dr. W. F. Dearborn's growth study. As many persons knew that the study involved many more than 275 girls, some have wondered why I took only the 275 for whom records were available for each and every one of the ten years from 7 to 16.

The answer, unless I am mistaken, is to be had by considering the aims of a growth study. If we desire to establish stable norms of height and weight or of other measurements at different ages we should take, of course, large samples because the standard error σ of an average is that of the distribution divided by the square root of the number n in the sample. Thus at 13 the average height was 153.40 cm with a standard deviation of 7.42, which means 153.40 ± .45 for the average if based on only 275 girls, whereas if we had measurements of four times as many the standard deviation of the mean would be only .22. However, for such norms one need not trouble with the continuity involved in growth studies; one could make a cross-sectional survey involving a large number of persons at each of the different ages.

Growth, however, is a continuous process and the amount of growth between two given ages is measured by a difference or increment in the measures. If we have l girls of one age and m different girls of another age as in cross-sectional studies with means Z and W, respectively, for some measurement and with standard deviations σ_z and σ_w, the sampling error of the difference $W-Z$ would be

$$\sigma^2_{W-Z} = \frac{\sigma^2_w}{m} + \frac{\sigma^2_z}{l};$$

but if we had n girls of both ages, as in growth studies, and the averages were X and Y, the sampling error of the difference could be obtained directly from the differences $y-x$ or indirectly from the correlation coefficient r between corresponding values of x and y as

$$\sigma^2_{Y-X} = \frac{\sigma^2_x + \sigma^2_y - 2r\sigma_x\sigma_y}{n}.$$

In cases in which r is high this value may be much smaller than the former when the number of persons involved is about the same, or, to put it differently, the second value may be statistically as good from a relatively small number of individuals, as the first is from a much larger number.

For example, the lowest correlation of the heights in successive years was found to be $r=.96$. If we assume σ_x and σ_y nearly enough equal so that they may be put equal, and equal to σ_z, σ_w for corresponding ages, without serious error, and if we take $l=m=n$ the first formula gives $2\sigma^2_x/n$ and the second gives $2\sigma^2_x(1-r)/n$ or only .04 as much; to put it inversely, we should have to have $l=m=25n$ to obtain from the first formula a sampling error as small as that obtainable from the second, or we should need nearly 6,400 girls taken at each of the years to give as good an estimate of average growth as we got from 275 taken at both years—provided we trust our statistical formula.[1]

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[1] This proviso may seem odd. We have, however, to remember that statistical formulas are mathematical theorems proved on certain assumptions which may not hold

This raises the further question of how to combine the data in case there are, as there needs must be, irregular omissions in the data. It is a general rule of statistics that if we have two independent and consistent[2] estimates Q_1 and Q_2 of a quantity with two standard deviations σ_1 and σ_2, the weighted mean $Q = pQ_1 + (1-p)Q_2$ will have the smallest value of σ_Q when $p = \sigma_2^2/(\sigma_1^2 + \sigma_2^2)$ and $\sigma_Q^{-2} = \sigma_1^{-2} + \sigma_2^{-2}$. Hence, applied to the estimates of amount of growth $Y - X$ and $W - Z$, the best estimate would have the sampling error

$$G = \frac{\sigma^2_{W-Z}(Y-X) + \sigma^2_{Y-X}(W-Z)}{\sigma^2_{W-Z} + \sigma^2_{Y-X}}.$$

$$\frac{1}{\sigma^2_G} = \frac{n}{\sigma_x^2 + \sigma_y^2 - 2r\sigma_x\sigma_y} + \frac{1m}{l\sigma_w^2 + m\sigma_z^2}$$

If we use for illustration the assumption $\sigma_x = \sigma_y = \sigma_w = \sigma_z$, $l = m = tn$,

$$\sigma^2_G = \frac{2\sigma_x^2(1-r)}{n} \cdot \frac{1}{1+(1-r)t},$$

and it is clear that if r is large so that $1-r$ is small, t must be considerable before an appreciable reduction is made in σ_G.

It is well known in statistics that the sampling error of a quantity involves the method of estimating the quantity. Thus if a universe is symmetrical, its center may be estimated from a sample drawn from the universe by the mean of the sample or by its median or by its mode or by the mean of the least and of the greatest element in the sample, but the standard deviations of the four estimates will be different. So in the above problem if we should undertake to form from X and Z at the earlier age and from Y and W at the later age the overall age means

$$\frac{nX + lZ}{n + l} \text{ and } \frac{nY + mW}{n + m}$$

and their difference

$$G = \frac{nY}{n+m} - \frac{nX}{n+l} + \frac{mW}{n+m} - \frac{lZ}{n+l}$$

we could get σ^2_G as

$$\sigma^2_G = \frac{n\sigma_y^2}{(n+m)^2} + \frac{n\sigma_x^2}{(n+l)^2} - \frac{2nr\sigma_x\sigma_y}{(n+m)(n+l)} + \frac{l\sigma_z^2}{(n+l)^2} + \frac{m\sigma_w^2}{(n+m)^2},$$

but this would be a bad way to estimate G if r were large and l and m were not large compared with n. Indeed, if we take the simple illustrative case as before, $\sigma_x = \sigma_y = \sigma_z = \sigma_w$, $l = m = tn$ we have

$$\sigma^2_G = \frac{2\sigma_x^2(1-r)}{n(1+t)^2}\left[1 + \frac{t}{1-r}\right]$$

This is greater than if we had omitted altogether the extra observations which were not common to both years unless $t \geqq (2r-1)/(1-r)$. If $r = .96$ we should have 23 *times* as many non-common as common observations before we should be as well off using general means to estimate growth.

This discussion will show, it is hoped, how important it is when establishing norms for increments of growth (*i.e.*, of *growth*) to maintain throughout the study a discipline on the part of the students and of the studied which will bring about the maximum continuity of the record.

OBITUARY

WILLIAM REES BREBNER ROBERTSON

1881–1941

W. R. B. ROBERTSON was born on May 31, 1881, and spent his early life on a farm at Manchester, Kansas. He died in Iowa City on March 15, 1941. He was one of C. E. McClung's eager students of cytology in the University of Kansas (A.B., 1906; A.M., 1907). He also studied with E. L. Mark, 1909–1912, in Harvard (Ph.D., 1915). He then spent the rest of his

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for the observations to which the formulas are applied. Thus if the theoretical sampling error of some quantity Q for samples of n items be σ, and if we take a considerable number of samples of n items we may find that the standard deviation of the values of Q observed in the different samples is considerably more than the theoretical value σ. If we evaluate the amount of growth by subtracting averages taken for two groups at each of two ages and also evaluate it by averaging the amount of growth between those ages for a single group measured at both ages, doing this a considerable number of times for different single groups on the one hand and for different pairs of groups on the other, we may well find that the variations observed are not those given by theory and further that they are not in the same ratio as that given by theory. It often takes extended experience to correct for such differences between theory and observation, but in the absence of such experience we have to make our estimates according to the theory.

[2] The qualification that the estimates have to be consistent is usually omitted. There are cases to be found in the literature where inconsistent estimates have been combined by the rules which I believe to be appropriate only for consistent estimates. Thus W. S. Eichelberger and Arthur Newton, "The Orbit of Neptune's Satellite and the Pole of Neptune's Equator," Astronomical Papers of the American Ephemeris, Vol. 9, Pt. 3, 1926, pp. 275–337, discuss on p. 329 the value of the reciprocal of the mass of Neptune, finding from reduction of the visual observations 19176 + 25 and from reduction of the photographic observations 19655 ± 36. The difference is 479, which is many times as much as would be consistent with the indicated errors, yet they obtain 19331 ± 21 by combining the observations as if they were consistent, even reducing the estimated error of the combination in accordance with the rule. With the high standard in the reduction of observations set for the American Ephemeris and Nautical Almanac by Simon Newcomb over many years, I have to be somewhat hesitant in suggesting the above criticism, yet I must say that I have never seen any theory of least squares which seems to me to validate the process by which the final result 19331 ± 21 is obtained from its immediate antecedents.

life in the University of Kansas, the University of Missouri, the Kansas Agricultural Experiment Station and the University of Iowa. He was a life member of the Kansas Academy of Science; fellow of the American Society of Zoologists; member of the American Society of Naturalists, the Genetics Society, Medical Association, Poultry Society, Eugenics Research Association, Phi Beta Kappa, Sigma Xi and others.

Robertson's early papers, 1915–17, dealt with chromosomal inequalities, deficiencies, shapes and homologies in relation to synapsis, taxonomy and genetics in seven species of the subfamily Tetriginae, as well as in a few species of the larger grasshoppers. During the period of 1920–27, he derived a valuable set of data, including many skins and feather samples, from the extensive breeding of turkeys to which he devoted himself with meticulous care and great zeal. He never published on the turkey data but left them in such form that they will be available, it is believed, for forthcoming contributions of importance to the understanding of inheritance in these birds.

In 1927, Robertson came to the Department of Zoology of the Kansas State College as guest collaborator. He remained for three years, devoting himself exclusively to the cytogenetics of *Paratettix texanus* Hancock and *Apotettix eurycephalus* Hancock. He published five papers in 1930 and 1931 covering the work of this period. These researches dealt with the chromosomal relations in partheno-produced (I think that he introduced this useful word) pigmy locusts, including gonomeric grouping, synapsis-like tendencies, types of parthenogenesis, hybrid vigor, split chromosomes, the origin of the rarely partheno-produced males and other cytogenetic features of partheno-production. Subsequent joint papers (1933, 1941) have reported on inheritance in *Corthippus longicornis* and his accurate concatenation of cytology with the gross genetics of x-ray induced aberrancies in *A. eurycephalus,* including an autosome-sex chromosome translocation.

Robertson was extremely sensitive by nature and, like most people of similar dispositions, he commonly misconstrued the intentions and actions of his family, friends and colleagues to a greater degree, perhaps, than he was himself misunderstood and ill-judged. Nevertheless, he was a staunch and loyal friend and beneficently devoted to the welfare and progress of his students, the work of several of whom he directed to doctorate theses. As a scientist he was extraordinarily painstaking, exacting and demanding of high standards in his own and students' researches. Consequently, he proceeded slowly and, when measured beside stream-lined researches, perhaps awkwardly, and thus in at least a few instances he was subjected to the facile and inconsiderate opprobrium of dilatoriness. Due to his peculiarly sensitive nature he was unable to meet such imputations with that saving complex of disdain, aplomb and sense of humor so essential to the peace of mind and welfare of the creative and critically experimental scientist such as he was. But let it be recorded to the enduring excellence of Robertson's scientific character that, although staggered by the forces of financial, spiritual and professional embarrassment, he never relented nor deviated from the high and exacting standards which he had irrevocably set for himself in the days of his apprenticeship with McClung and Mark. It was during one of the most distressing periods for him that the research which will perhaps eventually be considered of considerable significance was accomplished.

In 1930, Robertson went to the University of Iowa. There, with the sagacious, understanding and genial MacEwen, Bodine, Ingram, other staff members and graduate students as colleagues, his long perturbed, thwarted and lonesome spirit was restored to a degree of composure and hope such as he had scarcely experienced since those early days of happy participation in the beginnings of cytogenetics on Mt. Oread. These remaining eleven years of his life were happily devoted to teaching, graduate students, various researches, including further cytogenetics of x-rayed pigmy locusts and some larger grasshoppers. He also gave attention to human heredity and contributed a chapter dealing with the biological background of the family to Jung's "Modern Marriage."

ROBERT K. NABOURS

DEATHS AND MEMORIALS

PROFESSOR WILMER E. DAVIS, professor of plant physiology at the Kansas State College of Agriculture and Applied Science, died on January 17 at the age of seventy-five years.

DR. CHARLES DAVISON, professor emeritus of surgery at the University of Illinois College of Medicine, died on January 19 at the age of eighty-four years.

DR. HARRY CAPPS, assistant professor of psychology, Louisiana State University, soon to have been inducted into the Army, died by suicide on January 17. He was thirty-three years old.

DURING the recent celebration of the fiftieth anniversary of the founding of the School of Mines of the University of Minnesota, the Board of Regents honored its founder and first dean, the late William Remsen Appleby, by naming the School of Mines building "Appleby Hall." A plaque, unveiled at a ceremony in his honor on January 13, will be placed in the building. Dean Appleby served the School of Mines from its foundation in 1892 until his retirement in 1935. He died on April 8, 1941.

A FELLOWSHIP honoring Walter Lindsay Niles, dean of Cornell University Medical College and attending physician at the New York Hospital, who died on December 22, has been announced by the two institutions. An endowment fund of $100,000, of which more than a fourth has been pledged in advance, is being raised by friends and colleagues of Dr. Niles to provide annual awards to outstanding young men entering the medical profession. The committee directing the effort includes: Dr. Bruce P. Webster, *chairman,* Mrs. Roger W. Straus, Walter C. Teagle, Neal Dow Becker, William H. Jackson, president of the Society of the New York Hospital; Dr. Edmund E. Day, president of Cornell University, and Dr. Malcolm Goodridge, president of the New York Academy of Medicine.

THE three-hundredth anniversary of the death of Galileo Galilei, on January 8, 1642, will be celebrated at the New York Academy of Medicine by placing on exhibit a collection of works and illustrations bearing on his life and accomplishments. The exhibit will be placed on view in connection with the delivery of the ninety-second Anniversary Discourse of the New York Academy of Medicine. Dr. A. A. Brill will deliver the address on "The Freudian Epoch." Both the exhibit and the meeting are open to the public.

SCIENTIFIC EVENTS

THE FOURTH EXPEDITION TO GUATEMALA OF FIELD MUSEUM

WITH plans for completing comprehensive botanical researches, and the collecting of plants representing the varied flora of Guatemala, the fourth botanical expedition to that country for Field Museum of Natural History sailed from New Orleans on December 3. Dr. Julian A. Steyermark, assistant curator of the herbarium, is in charge of the expedition. He is accompanied by Albert Vatter, of Glenview, Ill., a specialist in wild flower photography.

The three previous expeditions to Guatemala, one conducted by Dr. Steyermark, and the others by Paul C. Standley, curator of the herbarium, resulted in collections of many thousands of plants, and further thousands are expected from the present undertaking. This expedition will conclude the preparations for publication of a flora of Guatemala upon which Messrs. Standley and Steyermark have been engaged since 1938.

Dr. Steyermark and his assistant will remain in Guatemala for about ten months. The time will be devoted chiefly to the exploration of those areas which were not investigated by the previous expeditions, as well as to areas whose wealth of vegetation demands greater attention than has been possible to accord it hitherto. Guatemala, despite its small size, has an extensive and varied flora due to the extreme diversity of terrain it offers for plant environments, ranging from plains to high mountains, and from desert to tropical rain forests.

The most difficult task Dr. Steyermark faces is the collecting of plants during the rainy season from areas which at that time reach their maximum of floral development. This is a condition much to be desired from the standpoint of botanical study, but is hard on the explorer since the rainy season in Guatemala means the kind of constant heavy downpours which make life extremely uncomfortable for those who have to expose themselves to the weather.

GRANTS OF THE NATIONAL TUBERCULOSIS ASSOCIATION

THE Committee on Medical Research has recommended to the National Tuberculosis Association that during 1942–43 grants be awarded for:

Chemical Investigations of the Tubercle Bacillus, by R. J. Anderson, Sterling Chemistry Laboratory, Yale University.

Enzymes as Factors in Resistance to Tuberculosis, by M. C. Winternitz and Bruno Gerstl, Laboratory of Pathology, Yale University School of Medicine, and by H. W. Olson, Wilson Teachers College, District of Columbia.

Serum Studies using Tiselius Electrophoresis Apparatus, by Florence B. Seibert, Henry Phipps Institute, University of Pennsylvania.

Research in Roentgenological Technique, by Charles Weyl and S. Reid Warren, Jr., Moore School of Electrical Engineering, University of Pennsylvania.

Variations in Virulence by the Omental Spread Method, by C. E. Woodruff, Wm. H. Maybury Sanatorium, Northville, Mich.

Relation between Diabetes and Tuberculosis, by M. M. Steinbach, Columbia University.

Decision on grants for clinical studies in Boston and New York was deferred pending an investigation by a special subcommittee into the best method of coordinating these independent projects with studies being considered by the American Trudeau Society. Grants considered at this time are not effective before July 1, 1942.

The members of the Committee on Medical Research are: Dr. Wm. Charles White, *chairman,* Dr. Charles

J. Hatfield, Dr. Kendall Emerson, Dr. J. Burns Amberson, Jr., Dr. Ezra Bridge, Dr. Charles A. Doan, Dr. Leroy U. Gardner, Dr. Esmond R. Long, Dr. Karl F. Meyer, Dr. Florence R. Sabin and Dr. David T. Smith.

THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE third annual report of Basil O'Connor, president of the National Foundation for Infantile Paralysis, has appeared. It covers the period from October 1, 1940, to September 30, 1941. During the year the foundation received a cash income of $1,036,480. Seventy-two grants and appropriations were made, amounting to $805,562. These grants were awarded for Virus Research, for Nutritional Research, for After-Effects Research, for Education and for Epidemiology—Epidemics. They include:

The University of Wisconsin, $62,500, to study the metabolism of monkeys as a part of the study of the influence of nutrition on susceptibility to poliomyelitis.

University of Michigan School of Public Health, $40,000, to continue to give aid for the express purpose of creating facilities to train virologists and to study virus diseases, with particular emphasis on poliomyelitis.

University of California, the George Williams Hooper Foundation, $15,000, to continue and extend studies in the epidemiology of poliomyelitis in the eleven Western states with special reference to human equine encephalomyelitis, St. Louis encephalitis and other types of encephalitis. $6,300, to conduct epidemiological studies; to study animals, birds, insects and humans for the presence of evidence of infection with viruses of St. Louis encephalitis, Western equine encephalomyelitis and poliomyelitis.

Harvard Medical School and Surgical Research Laboratory, Boston City Hospital, $3,000, to study the gastrointestinal tract as the portal of entry of virus in experimental poliomyelitis. $17,315, for the purchase of supplies for laboratory research studies.

Yale University School of Medicine, $13,000, to continue the study of the distribution of the virus of poliomyelitis in human beings and in nature, during epidemics and inter-epidemic periods.

The University of Southern California School of Medicine, $10,000, to continue laboratory studies of comparison of strains of poliomyelitis virus recovered in Los Angeles. $5,000, to conduct studies on isolation of poliomyelitis virus from asymptomatic non-contacts.

The Johns Hopkins University School of Hygiene and Public Health, $9,300, to conduct an epidemiological study of poliomyelitis by determining the disposition of poliomyelitis virus neutralizing antibodies among residents of an urban community.

University of Toronto, Connaught Laboratories, $8,800, to continue an attempt to develop more effective methods of recovery of poliomyelitis virus.

The Children's Hospital Research Foundation, Cincinnati, Ohio, $11,300, to continue to study the nature of human poliomyelitis, with particular reference to distribution of the virus in different levels of the alimentary tract; to study the distribution of poliomyelitis virus in cynomolgus monkeys succumbing to infection by the oral route; to conduct a search for poliomyelitis virus in flies trapped in epidemic areas.

IN HONOR OF DR. LIBERTY HYDE BAILEY

A GREAT palm glade on the shore of Biscayne Bay, Florida, is planned by the Fairchild Tropical Garden, Coconut Grove, Florida, in honor of Dr. Liberty Hyde Bailey, emeritus professor and formerly dean of the College of Agriculture of Cornell University.

It is anticipated that the glade of tropical palms, while serving as a permanent memorial to Professor Bailey, will be a mecca to thousands of garden lovers making pilgrimages to southern Florida to see what tropical palms really are.

Influential in the field of horticulture since the beginning of agricultural education in this country, Professor Bailey has devoted his life to conserving forests, improving rural schools, building departments of horticulture in colleges, bettering country life, stimulating plant selection and plant breeding, teaching landscape gardening for homes and through his "Hortus" and his "Encyclopedias," providing the plant lover with guides for determining the names of plants.

Professor Bailey in the last ten years has devoted attention to the palms, collecting them himself in the tropical jungles, classifying unknown sorts and building one of the world's best collections in the Bailey Hortorium in Ithaca, which he gave to the university.

It is planned to dedicate the Liberty Hyde Bailey Palm Glade on Dr. Bailey's eighty-fourth birthday, March 15, and to present him then with an album containing the names of all who have contributed. Dr. David Fairchild, retired U. S. Government botanist, the originator of the Fairchild Tropical Garden at Coconut Grove, Fla., is raising the funds for the palm glade. He is seeking nominal gifts "from the greatest possible number" of Dr. Bailey's friends and admirers. "To this end," Dr. Fairchild states, "it has been decided that no contribution shall be of more than one dollar."

Professor Bailey was born in Michigan. He attended the first agricultural college established near Lansing, Michigan. His affiliation with Cornell began in 1888 when he became professor of horticulture; from 1903 to 1913 he was director and dean of the College of Agriculture of the university. He has worked in the jungles of Central America, Mexico, Cuba and other countries for his collections, the palm collection constituting one of the best in the world.

As a result of his support of the Fairchild Tropical Garden, of which he has been a member since its inception, the directors of this organization now have chosen to honor him with a memorial that is expressive of his great interest in the palm tree. To quote Professor Bailey's own words:

> The palms represent what is commonly considered to be the noblest family of plants; and yet they are to this day perhaps the least perfectly known, in general, of any of the great groups of vegetation. . . . The utility of palms is bound to take new directions and to increase, both as ornamental and interesting objects and as sources of important supplies.

THE MEMPHIS MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE 103rd meeting of the American Chemical Society will be held in Memphis from April 20 to 24 under the presidency of Dr. Harry N. Holmes, head of the department of chemistry at Oberlin College. It is expected that more than 3,000 chemists will be in attendance. Sessions will be held by seventeen of the eighteen divisions, embracing practically every field of chemical science. Many of the papers will deal with chemical developments in the South and in the Memphis area. Numerous special symposia, devoted to recent progress in medicinal chemistry, vitamins, nutrition, agriculture and other fields have been arranged. Experts from all parts of the country will participate.

Reports before the divisions will describe the latest researches in rubber, petroleum, plastics, sugar, agriculture and food, gas and fuel, cellulose, water, sewage, and sanitation, paint and varnish, biological chemistry, analytical and micro chemistry, industrial and engineering chemistry, colloid chemistry, organic chemistry, physical and inorganic chemistry, chemical education and history of chemistry.

W. F. Bowld, general manager of the Buckeye Cotton Oil Company, Memphis, has been appointed general chairman of the convention committee. The honorary chairman is Dr. Victor A. Coulter, of the University of Mississippi. The following have been chosen vice-chairmen: L. N. Rogers, chemical director of the cellulose division, Buckeye Cotton Oil Company; E. R. Barrow, secretary-treasurer of Barrow-Agee Laboratories, Memphis; Paul D. Bowers, chief chemist of the Firestone Tire and Rubber Company of Tennessee; Thomas P. Nash, Jr., dean of the School of Biological Sciences at the University of Tennessee.

The Memphis Section of the society, of which Dr. Nash is chairman, will be host to the visiting chemists. Arrangements are being made at the headquarters of the society in Washington, D. C., under the direction of Dr. Charles L. Parsons, secretary and general manager of the society.

In addition to the professional sessions, meetings will be held by the Council and Board of Directors. Dr. Holmes will preside at the meetings of the council on Monday, April 20. Dr. Thomas Midgley, Jr., of Worthington, Ohio, vice-president of the Ethyl Gasoline Corporation, will preside on Sunday, April 19, at the meeting of the board, of which he is chairman.

Registration will begin on Sunday, April 19, at 2 P.M., in the Memphis Municipal Auditorium. The opening event of the convention will be a general meeting in the Auditorium on Monday, April 20, at 2 P.M.

A program of social and educational events has been arranged, including group luncheons and dinners. The dinner of the society will be given on Wednesday, April 22. Trips will be made to points of industrial and historical interest in the Memphis area.

SCIENTIFIC NOTES AND NEWS

THOMAS MIDGLEY, JR., vice-president of the Ethyl Gasoline Corporation and discoverer of tetra-ethyl lead, which has made possible great advance in automotive and aircraft engines, has been awarded the 1942 Willard Gibbs Medal of the Chicago Section of the American Chemical Society, in recognition of his "discoveries which are outstanding both from the standpoint of pioneering in new fields and from the standpoint of commercial importance." The presentation will be made at a meeting of the section on May 22.

THE 1941 Lawrence B. Sperry Award of $250 of the Institute of the Aeronautical Sciences has been given to Ernest G. Stout, engineer for the Consolidated Aircraft Corporation of San Diego, Calif., "for a notable contribution by a young man to the aeronautical sciences." The award was made in recognition of Mr. Stout's work in improving take-off and landing characteristics of flying boats and seaplanes. It was presented on January 27 at the honors-night dinner of the institute at the Hotel Waldorf-Astoria, New York City.

A COMMEMORATIVE volume prepared by a group of former graduates of the department of psychology of Stanford University was presented to Professor Lewis Madison Terman, since 1922 chairman of that department, at a dinner in honor of his birthday, given on January 15 by Judge and Mrs. William F. James.

The volume, "Studies in Personality, Contributed in honor of Lewis M. Terman," contains sixteen original research papers prepared by psychologists who in the past have worked under his direction. The papers range from studies of personality development and measurement to studies of psychical belief and abnormal phenomena. The volume includes an introduction by Professor Robert S. Woodworth, emeritus professor of psychology at Columbia University, and a bibliography of Professor Terman's writings. Editors of the volume were Dr. Maud Merrill James and Dr. Quinn McNemar, members of the faculty of psychology.

Nature reports that Professor Hermann Steudel, emeritus professor and director of the Institute of Chemical Physiology at Berlin, has been awarded the Goethe Medal for Art and Science on the occasion of his seventieth birthday.

At the forty-fourth annual meeting of the Washington Academy of Sciences, on January 15, Dr. Harvey L. Curtis, of the National Bureau of Standards, was elected *president;* Frederick D. Rossini, of the National Bureau of Standards, *secretary,* and Howard S. Rappleye, of the U. S. Coast and Geodetic Survey, *treasurer.* Other officers for 1942 are as follows: *Archivist,* Nathan R. Smith; *Editors of the Journal,* Raymond J. Seeger, G. Arthur Cooper and Jason R. Swallen; *Custodian and Subscription Manager of Publications,* William W. Diehl; *Committee on Membership,* Frank C. Kracek, *chairman; Committee on Meetings,* Clement L. Garner, *chairman; Committee on Monographs,* Henry B. Collins, Jr., *chairman; Members of the Board of Managers,* John E. Graf, Frank H. H. Roberts, Jr., Ferdinand G. Brickwedde, Henry B. Collins, Jr., William G. Brombacher, Ernest P. Walker, Herbert L. Haller, Austin H. Clark, Alexander Wetmore, John B. Reeside, Jr., Fred O. Coe, Allen C. Clark, James E. McMurtrey, Jr., Aleš Hrdlička, William A. Dayton, Paul C. Whitney, Francis B. Silsbee, Walter Ramberg, Emmett W. Price, Leland W. Parr, Clement L. Garner, Herbert Grove Dorsey and Herman Stabler.

The Association for Symbolic Logic announces the following elections: *Secretary-Treasurer,* for a term of three years, Dr. J. C. C. McKinsey, of New York University; as members of the *Executive Committee,* for a term of three years, Professor Paul Marhenke, of the University of California, and Professor Alfred Tarski; as member for a term of one year, Professor Arnold Dresden, of Swarthmore College. The council of the association has appointed Dr. J. C. C. McKinsey, of New York University, to be *Managing Editor* of the *Journal,* and has reappointed Professor Alonzo Church, of Princeton University, as *editor,* each for a term of three years.

At the Dallas meeting of the Union of American Biological Societies, Dr. Anton J. Carlson, Frank P. Hixon distinguished professor of physiology, emeritus, of the University of Chicago, was elected president.

Officers of the Entomological Society of America have been elected as follows: *President,* Dr. C. P. Alexander, Massachusetts State College; *First Vice-president,* Professor Miriam A. Palmer, Colorado State College; *Second Vice-president,* William T. Davis, Staten Island, N. Y.; *Secretary-Treasurer,* Dr. Clarence E. Mickel, University of Minnesota.

Bronislaw K. Malinowski, of Yale University, who now holds the position of Bishop Museum visiting professor of anthropology, has been appointed professor of cultural anthropology at the university, effective on July 1.

Dr. Russell F. Sullivan, of Brookline, Mass., has been appointed professor of orthopedic surgery at Tufts College Medical School. Dr. Sullivan was a graduate of the college in 1918.

Dr. Fred W. Rankin, of Lexington, Ky., president-elect of the American Medical Association, has been appointed chief consulting surgeon of the Army and will assume the post on March 1 with the rank of colonel. He is a son-in-law of the late Dr. Charles Mayo.

The *Journal* of the American Medical Association reports that Dr. Lewis R. Thompson, Washington, director of the National Institute of Health and assistant surgeon general in charge of scientific research, has been appointed chief inspecting officer of the U. S. Public Health Service, a new position established in the Office of the Surgeon General. As a result of the increased demands on the Public Health Service because of the expansion of programs of civilian and military defense, the field activities of the district offices of the Public Health Service and its liaison officers in the army corps areas have been consolidated under one head. Dr. Rolla E. Dyer, chief of the Division of Infectious Diseases and assistant director of the institute, has been named to succeed Dr. Thompson as assistant surgeon general in charge of the Division of Scientific Research and as director of the National Institute of Health, effective on February 1.

Dr. J. Percy Moore, research fellow of the department of mollusks and chairman of the library committee of the Academy of Natural Sciences of Philadelphia, has been elected a member of the Board of Trustees.

Dr. Raymond G. Spencer, formerly associate professor of physics at Albion College, has been appointed chairman of metallurgical research of the Armour Research Foundation.

Dr. Alexander Forbes, professor of physiology at the Harvard Medical School, has become the first president of the George Junior Republic Association, Inc., formed by a merger of the association and the Boy Conservation Bureau.

According to a United Press dispatch, Dr. Karl Otto Heinrich Lange, instructor at Blue Hill Meteorological Observatory, Harvard University, formerly research physicist for the German Government, has been in Federal custody as an enemy alien since December 8.

President Roosevelt has appointed Dr. George Baehr, chief medical officer of the Office of Civilian Defense, to be a member of the Health and Medical Committee of the Office of Defense Health and Welfare Services. Dr. Irvin Abell, Louisville, Ky., chairman of the Committee on Medical Preparedness of the American Medical Association, is chairman of the Health and Medical Committee and other members are the Surgeon General of the U. S. Army, Major General James C. Magee; the Surgeon General of the U. S. Navy, Rear Admiral Ross T. McIntire; the Surgeon General of the U. S. Public Health Service, Dr. Thomas Parran, and the chairman of the Division of Medical Sciences, National Research Council, Dr. Lewis H. Weed, Baltimore. The Office of Defense Health and Welfare Services is a part of the Office for Emergency Management, which in turn is part of the Executive Office of the President. The director of the Office of Defense Health and Welfare Services is Paul V. McNutt, who is also Federal Security Administrator.

The Hitchcock lectures of the University of California will be given by Dr. A. H. Reginald Buller, emeritus professor of botany at the University of Manitoba, during the month of February. The titles of the lectures are as follows: "Mushrooms and Toadstools as Organs for the Production and Liberation of Spores"; "Hyphal Fusions and Protoplasmic Streaming"; "The Sexual Process in the Rust Fungi"; "Recent Discoveries Concerning the Bird's-Nest Fungi."

Dr. Norman Jolliffe, associate professor of medicine at New York University, a member of the nutrition committee of the National Research Council, gave the first of a series of lectures and discussions on nutrition on January 14 at the School of Education of New York University. The lecture was entitled "The Prevalence of Malnutrition."

Nature states that a dietetic council has been set up in Ireland under the leadership of Dr. P. T. Farrell to experiment on ways and means of aiding the people's nutrition under war-time conditions, paying special attention to the diet of children.

The Mexican Embassy in Washington announces that the President of Mexico, General Manuel Avila Camacho, has issued invitations for an Inter-American Scientific Congress to be held in Mexico from February 16 to 26. Ambassador Castillo Najera said that scientific men and scholars from all the countries of the Western Hemisphere had been invited to attend, and that acceptances already had been received from thirty residents of the United States. The conference will coincide with the dedication of the new Mexican National Astrophysical Observatory at Tonanzintla, State of Puebla.

The first Mexican Congress of Internal Medicine will be held in Mexico City from May 3 to 10, under the auspices of the President of Mexico and the Departments of Education and Public Health, with the cooperation of the medical societies of Mexico and the National University. The congress will be made up into various sections covering a wide range of subjects.

The second Congress of Dental Education and Licensure, conducted by the Council on Dental Education of the American Dental Association, will take place at the Palmer House, Chicago, on February 21. Dr. Franklyn Bliss Snyder, president of Northwestern University, will make an address on "The University and Professional Education."

At a recent meeting of the executive committee of the National Parks Association, the importance of carrying on its educational program was emphasized. It is planned to continue the advocacy of National Primeval Parks as a distinct category, to promote worthy park projects that have already been authorized, to encourage appreciation and the proper use of America's natural and historic heritage, to combat each threat of commercial encroachment upon protected reservations and to divert destructive uses of all kinds from superlative natural areas.

The Bermuda Biological Laboratory for Research, Inc., has established scholarships for work in Bermuda for a limited number of special investigators. Although the original laboratory building is not available, working space with simple equipment and running sea water has been placed at the disposal of biological workers at the Government Aquarium through the kindness of its director, Dr. Louis Mobray. The scholarship stipend is intended to cover travel and living expenses. Should travel to Bermuda become impossible or inadvisable, scholarships might be awarded for work at a laboratory in some part of the United States having a semitropical marine fauna or flora. Applications giving an outline of the proposed investigation, the place of proposed study and the time of stay should be sent to the Committee on Award, care of Dr. Columbus Iselin II, Woods Hole Oceanographic Institution; Professor Ross G. Harrison, Yale University, or Professor E. Newton Harvey, chairman, Princeton University.

Appointment for the year 1942–43 to the Charles W. Hargitt Research Fellowship in Zoology, at Duke University, will be made on March 15. The fellowship for post-doctoral work, carrying a stipend of $1,000, is restricted to research work in cytology; appointment is for a single year with the possibility of reappointment. Applications must be filed by March 1. Inquiries should be made to, and application blanks obtained from Dr. Geo. T. Hargitt, Biology Building, Duke University, Durham, N. C.

After over thirty years of operation with a mechanically recording Wiechert seismograph, the Spring Hill College Seismological Observatory (Mobile, Ala.) began the New Year of 1942 with the installation of two sensitive photographic instruments. Two drum synchronous motor-driven recorders and two rebuilt McComb-Romberg tilt-compensating seismometers have been sent on indefinite loan to the observatory by the Franklin Institute of Philadelphia. The seismographs were used in Little America during the last Antarctic expedition of Rear Admiral Richard E. Byrd. The U. S. Coast and Geodetic Survey undertook to rebuild and increase the sensitivity of the instruments and assisted in placing them in operation. The seismologist in charge of the Spring Hill Observatory is Fr. A. J. Westland, S.J., who recently completed four years special study in seismology under the direction of Rev. Dr. J. B. Macelwane, S.J., director of the Institute for Geophysics at St. Louis University.

DISCUSSION

SEX-DETERMINATION IN MELANDRIUM AND LYMANTRIA

In a series of reports Warmke and Blakeslee[1] announced the important discovery that in Melandrium the Y-chromosome contains the male-determining factors balanced against the female ones in the X-chromosomes, the autosomes playing hardly any role in the mechanism. This constitutes a mechanism identical with what I had considered for many years to be the situation in Lymantria (of course with M and F exchanged on account of female heterogamety, ♀ = XY or WZ). In Lymantria it is unequivocally proven that the male determiners (M) are located in the X-chromosomes and that the female determiners (F) are inherited maternally, the autosomes containing only secondary modifiers for femaleness. This maternal inheritance of F, confirmed in innumerable and decisive checks, may mean either cytoplasmic or Y-chromosome localization. I decided for the Y-chromosome when cases were found in which a weak female crossed to a strong male produced, in addition to sex-reversal males, a few exceptional females which turned out to be strong and inherited this character maternally. This excludes the cytoplasm and can be explained by non-disjunction and fertilization by an XXY male from the strong race. Thus I considered the location of F in the Y-chromosome as most probable and repeatedly discussed the consequences. Having for about 15 years accepted this solution, which was borne out by all available facts, I finally made up an experiment which I considered crucial.[2] The idea was the following: If F is located in the Y-chromosome, a sex reversal male produced by crossing a weak mother to a strong father is XY and therefore has a weak F in the Y-chromosome, a strong M in the X. Some of the daughters of such males derive their Y from the XY-father, which is then a Y with a weak F. This can be tested by crossing all daughters to strong males. If F is located in the Y-chromosome a part of the crosses will produce only males (half by sex-reversal). This experiment carried out with over 100,000 individuals never gave an all male brood. I considered this final proof in favor of the cytoplasm, though the above-mentioned data, explained by non-disjunction and location of F in the Y-chromosome, now became unexplainable, though the facts were found over again.

Blakeslee's new work suggests a need for reconsidering the situation: perhaps, after all, the old explanation was correct, and the sex-determining mechanism is the same as in Melandrium. To answer this question it is necessary to re-examine the experiment, considered to be crucial, for a possible loophole. The test presupposes, first, that half of the F_1 individuals from all-male broods are XY, as had been found in previous work; second, that in the offspring of these males females are present which have been sired by sex-reversal males. As 168 F_1 males were crossed and 365 daughters tested by recrossing with strong males, we assumed that XY-males could not have escaped detection. Actually 10 per cent. of the crosses with F_1 males were sterile. Now that Blakeslee's work focuses attention again on the Y-chromosome, the question has to be asked (not overlooked in the original paper) whether these sterile crosses were not the only ones sired by a sex-reversal male. If this were the case, the experiment would no longer be crucial. After Blakeslee's work I am inclined to this conclusion and to assume that my original conclusion as to the location of F in the Y-chromosome, backed by weighty experimental evidence, was the correct one. A decisive experiment could be planned, but its execution would require definite Japanese races of the gypsy moth, a condition which precludes a check for the time being.

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[1] See H. E. Warmke and A. F. Blakeslee, Science, 89: 1939, *et al.*

[2] R. Goldschmidt, *Ztschr. ind. Abstl.*, 67: 1934; *Bibl. genet.*, 11: 1934.

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MAN'S BIOLOGICAL FUTURE

THE discussion of man's biological future started by Blackwelder[1] and continued by Goodale[2] and Miller[3] still leaves much unconsidered. Blackwelder states the case thus (p. 365):

> Just as it would have been difficult for even a most intelligent trilobite to imagine the fish, which was destined to drive him from the scene, so it is not easy for us to forecast the nature and potentialities of that new species of *Homo* which may appear in the distant future—unless indeed our genus itself has by that time run its course and is not destined to offer the world anything further. . . . The only way in which he is likely to outstrip *Homo sapiens* effectively is in the quality of his brain.

To these pessimistic implications that man may not be able to hold his own against some hypothetical new species of *Homo*, Miller adds three further pessimistic implications, namely (1) man's giantism, (2) his racial old age and (3) his specialized type of social behavior; pessimistic because of the implication that specialization has proved dangerous in paleontological history.

To this, should be added the speculations of Howard,[4] who in comparing man with insects concludes (p. 5) that

> insects have had 12,500 times the chance that man has had to evolve a persistent type. . . . Man, then, is a newcomer. He may be a fugitive inhabitant of the world, speaking in geological terms, but . . . the possession of characteristics (insects) . . . would seem to assure their persistence even if such an experiment of Nature's as the human species should be found eventually to be an unfortunate and unsuccessful one. . . .
>
> It seems as though the insects were quite the most permanent and persistent type that life has evolved. . . . (p. 8) for the consideration of our present existence and of our relation to the forms of life that coexist with us it is not too much to assume that insects will be here when we are gone. I am inclined to think . . . that the last living thing on the globe will be some active insect sitting on a dead lichen which will represent the last of the life of the plants.
>
> But there may come a cataclysm, in which case the human species may be wiped out, . . . (p. 9) Tillyard has found in New Zealand a primitive caterpillar feeding on a liverwort . . . and this insect type appears to have remained unchanged for millions of years. What is a cataclysm or two to the insect class? . . . the insects have passed through cataclysm after cataclysm; and when they are subdued it will be safe for some possible historian in Mars to say "That is the end of that world."

To any possible objection about pessimism, Blackwelder has replied that a "scientist is under no obligation to be an optimist. His only concern must be to approach nearer to the truth." If truth offers hope, so much the better. Goodale offered hope that "man holds his biological destiny in his own hands." This, of course, assumes that man will direct his own evolution on the basis of his understanding of genetic principles.

But quite apart from man's control of his own evolution, there is evidence to indicate that man or his improved descendants will be able to cope with his competitive foes or forces of nature. The fact that man or his ancestors have been able to cope with and survive in face of all competition from longer persistent forms gives a ray of hope. His emergence from such competition to a dominating place among organisms where he has almost a monopoly on intelligence is positively encouraging.

The characterization of the present as an age of insects based largely on the enormous numbers both of kinds and individuals is scarcely tenable as an alternative to the age of man. It overlooks the fact that man's ancestors persisted in face of the opposition of the long established forms and gradually spread over most of the world, occupying nearly every terrestrial habitat suitable to his size despite the presence of insects or other animals already established there.

Primitive man having spread into nearly every part of the world, where he was confronted with varying environments, developed adaptations which met the differing conditions and produced differing races. Successful and prolific races sometimes over-ran less successful races and crowded them into oblivion. This appears to be the method of evolution. This interpretation is difficult to harmonize with Blackwelder's assumption (p. 365, line 9) that "new species originate not by gradual imperceptible changes, but by sudden mutations." His assumption leads to the idea that some new creature of human lineage will crowd out man, whereas, predicting from the past, man will probably evolve gradually via new Mendelian combinations, chromosome aberrations and gene mutations. There seems to be little chance for off-shoots to diverge from man.

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[1] Eliot Blackwelder, SCIENCE, 93: 359–366, April 18, 1941.

[2] H. D. Goodale, SCIENCE, 93: 618, June 27, 1941.

[3] Gerrit S. Miller, Jr., SCIENCE, 94: 163–164, August 15, 1941.

[4] L. O. Howard, "The Insect Menace." Century Company, 347 p.

What are the chances that some other species not of human stock may outstrip man? For comparative analysis, consider the birds. When they took to the air, they obtained a practical monopoly among vertebrates despite the prior claims of the pterosaurs and winged insects. With this monopoly, they were able to spread and differentiate into very successful groups. In doing so, they undoubtedly eliminated by competition many of the intermediate stages of development, so there are few forms left to indicate the steps in their evolution.

Man is in a similar position with his monopoly on intelligence. He was the first to develop it to the stage where it could be successfully applied to modification of his environment on a large scale. This environmental control is so enormous by comparison with other animals that he is transforming large sections of the world so as to produce increased density of his own population and his satellites at the expense of other creatures. In so doing, man seems, like the birds, to have crowded out intermediate forms, so there is now a large gap between man and his nearest primate relatives. But there is still a difference between the past divergent evolution of birds and the prospects for man. In contrast with birds which developed divergence in ecological isolation, man is now reversing the process. With his rapidly developing transportation facilities, he is tending to prevent isolation, thus providing more and more mixing of divergent hereditary characteristics of previously differentiated races.

With man applying his intelligence to the control of his biological competitors and with his biological destiny in his own hands (Goodale), it would seem that man has good cause to be optimistic despite the alleged dangerous specializations to which Miller called attention. There may be, however, enough generalized characters of man to nullify the purported dangers from such specializations. There seems to be nothing on the horizon in any direction which shows possibilities of taking leadership away from man or his descendants—certainly not the insects.

ANGUS M. WOODBURY

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DEMONSTRATION OF LABYRINTHULA PARASITE IN EEL-GRASS FROM THE COAST OF CALIFORNIA[1]

IN a recent publication of the U. S. Fish and Wildlife Service, Moffit and Cottam describe some current abnormalities in the feeding behaviors of brant along the Pacific Coast.[2] These appear to be related to the depletion of marine eel-grass, *Zostera marina*, that forms the preferred food of brant. Marked loss of the Pacific varieties of *Zostera marina* is limited to a few localities, and the condition is not comparable to the sudden wasting of Atlantic eel-grass in 1931.

At various intervals during the past year I have examined specimens of plants taken from affected beds without obtaining satisfactory evidence of parasitic activity. Recently, however, I received exceptionally well-fixed material in which I was able to demonstrate readily the *Labyrinthula* common to the diseased Atlantic eel-grass. The parasite was clearly present in two specimens collected from North Humbolt Bay, California, and from San Quentin Bay, Lower California. The beds from which they were taken were in good condition with few wasted plants. The *Labyrinthula* shows the same morphological features and peculiar distribution in recently invaded leaf tissue as in diseased leaves of Atlantic eel-grass.[3]

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A SYSTEM FOR THE FILING OF REPRINTS

ALTHOUGH we are in sympathy with the recent request of Professor McCay[1] regarding standardization of size of reprints it is not likely that all journals will respond to his suggestion. In any event the change could not be retroactive, and hence we are faced with the problem of filing reprints larger than the usual sizes. The author has adopted recently a system, which may not be original, though I have not seen it used elsewhere, which gives promise of being satisfactory. The present file contains more than two thousand reprints and reports.

Discarding the usual boxes the system makes use of small metal cabinets. The particular cabinet chosen[2] contains 27 drawers, each measuring 3″ × 9″ × 12″. In addition to accommodating the larger reprint sizes of which Professor McCay complains it is possible also to file typed reports (8½″ × 11″). Of advantage also is the adaptability of these cabinets to otherwise unused space in the laboratory or office. They may be placed flat against the wall (and stacked one upon another in tiers) or at the ends of desks, tables, etc. Use of these cabinets likewise eliminates the necessity of shelving, and thus an empty room may be converted to a reprint file room without expensive carpenter work. The flexibility of the system allows the addition of small units as needed or budget may permit. In the event the collection requires moving it is an easy task to crate the individual cabinets; this also spares one of the unwelcome task of sorting and filing following the move.

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[1] Contribution No. 311 of the Woods Hole Oceanographic Institution.

[2] J. Moffit and C. Cottam, Wildlife Leaflet 204, November, 1941, 26 p. (mim.), Fish and Wildlife Service, U. S. Department of the Interior, 1941.

[3] C. E. Renn, *Biol. Bull.*, 70 (1): 148–158, 1936.

[1] C. M. McCay, SCIENCE, n.s., 94: 415, 1941.

[2] Obtained from Hobart Cabinet Company, Troy, Ohio.

The author prefers a subject filing system to an alphabetical author listing, since the material is of most value when thought of in relation to subject. Such a file (for example, a departmental collection) is then of value to graduate students or others who know the subject upon which they seek information but who, as yet, may be unfamiliar with the various authors. In my collection all reprints are marked by me in the upper right-hand corner in red ink to indicate the subject, thus permitting secretarial or other aid in filing. A typed list, which is posted, indicates the scope of each section, and thus the collection is available to others without my aid. With the modern trend to research by projects involving several persons rather than the isolated individual the need becomes emphasized of a single large file useful to the group.

In many instances (for example, reports relating to physiology, serology, taxonomy, etc.) there may be too many reprints relating to a certain subject to form a workable unit. For these a series of drawers is devoted to subdivisions of the larger topic which in the case of "physiology" include carbohydrate metabolism, nitrogen metabolism, lipolysis, effect of environment on microorganisms, etc. With the aid of a card file there is no worry that a reprint which relates directly to two or more subjects may be "lost" in the file since additional cards may be entered in the various subject divisions with each of the cards marked to indicate the placing of the reprint in the file. Since the card file contains countless references from the original literature and abstract sources those cards for which a reprint is available are so marked. The author has found no value in an alphabetical author listing of the reprints for general use, though perhaps such a compilation might be desirable for library holdings of a gift collection.

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PER CENT.

IF instructions in an original paper or a laboratory text-book call for, say, a 40 per cent. aqueous solution of caustic soda, it is probable that what is required is a solution containing 40 g of NaOH per 100 cc of solution, which is actually a solution containing about 30 per cent. NaOH by weight. Less probably, 40 g in 100 cc of water is actually meant, that is 28.6 per cent. by weight. Just possibly the author may really mean 40 per cent., that is, 40 g NaOH dissolved in 60 g of water. But, in general, no indication is given as to what is meant. There is often similar ambiguity in instructions for preparing mixtures of fluids when concentrations are stated as volumes per cent. With concentrations up to about 10 per cent., when accuracy is not required, the ambiguity is not important, but with stronger solutions misunderstanding may be critical.

It may be claimed that the custom of using the term "per cent." for grams or volumes per 100 cc solution is so well established in American scientific literature that nobody would be misled by it. However, the writer has been misled at times and the custom is confusing since it is not universally followed. For instance, bottles of concentrated hydrochloric acid are labeled with the specific gravity and the percentage acid, the percentage being given in the correct sense, that is, in grams acid per 100 grams of solution. The "Handbook of Physics and Chemistry" uses "per cent." only in the correct sense and uses specific statements for the other senses, see, *e.g.*, "Tables of Specific Gravity of Aqueous Solutions" and "Tables of Physical Constants of Compounds."

The incorrect use of "per cent." seems to be largely confined to writers in biological sciences, but there is no reason why workers in these fields should be content to use slipshod terms. I would like to recommend that authors, when stating concentrations of solutions, should indicate exactly what is meant, by using unambiguous expressions such as n g per 100 cc solution, of n g per 100 cc solvent, or n g in m cc solvent.

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SPECIAL CORRESPONDENCE

THE BRITISH GRAHAM LAND EXPEDITION, 1934–37

THE Graham Land Expedition was primarily engaged in survey work on the west coast of Graham Land and the adjacent islands, in the Falkland Island Dependencies, Antarctica. Advantage was taken of the exceptional opportunities for zoological research, and the resulting reports are being published by the British Museum. The following, dated August to October, 1940, have come to hand:

Vol. 1, No. 1, pp. 1–139. G. C. L. Bertram. "The Biology of the Weddell and Crabeater Seals."

Vol. 1, No. 2, pp. 141–194. Brian Roberts. "The Life Cycle of Wilson's Petrel."

Vol. 1, No. 3, pp. 195–254. Brian Roberts. "The Breeding Behavior of Penguins."

Vol. 1, No. 4, pp. 255–294. S. M. Manton (Mrs. J. P. Harding). "On Two New Species of the Hydroid Myriothela."

Vol. 1, No. 5, pp. 295–318. Theresa Clay. "Anoplura."

The reports are beautifully printed, but a good deal of space could have been saved by a different arrangement of the text, while the very wide margins are undesirable from any point of view, and especially now that there is a shortage of paper. There are four species of Antarctic seals, the Weddell and Crabeater being the most abundant, the former being a species of the coasts and inshore waters, the latter of the pack ice. The Crabeater has a misleading name, as its food is Euphausiid Crustacea, shrimp-like creatures of the plankton. Perhaps Floe-seal would be a better name, though the scientific name *Lobodon carcinophagus* can not be altered. During the course of the expedition it was necessary to kill 558 seals to provide food for 16 men and about 80 dogs. Dr. Bertram took every opportunity of doing the actual killing and butchering himself, in order to obtain the desirable records from each specimen. The records thus obtained, together with the concurrent observations of the living animals, give us an account of the biology of these seals which leaves little to be desired, and to this is appended a discussion of the behavior of the thirty living Pinnipedia of the world.

Wilson's petrel, which breeds in the Antarctic, is discussed at length by Dr. Roberts. Summing up, he says that the migration of this bird is one of the longest and perhaps the most remarkable of any bird known. In a straight line the Atlantic migration is about 7,000 miles in each direction yet the flight throughout is indirect and quite unlike that of land birds crossing the sea. For the greater part of eight months of the year most of them probably never come within sight of a landmark, yet they return at almost the same date each year to the same burrow and mate. "Oceanic migration of this type provides a noteworthy example of powers of endurance, and it also raises the problem of orientation in its most difficult form. In view of such facts it is extraordinary that visual memory is still quoted as the most satisfactory explanation of the way in which birds orient themselves during migration."

Four subspecies of Wilson's petrel are recognized, but they are separated on average characters, so that individual birds taken on migration can not be referred to any particular race with confidence. Dr. Roberts says, "the division into four races may not be useful for museum purposes," but he feels that it is desirable to have names for the different populations, which, when studied on their breeding grounds, do show average differences. It is interesting to find that Euphausiid Crustacea are the food of Wilson petrel as well as the so-called Crabeater seal. The parent petrels regurgitate partly digested *Euphausia* for the chicks, "in the early stages this takes the form of a clear oil," but some of the chicks were found to contain almost complete *Euphausia*.

The bird lice found on the Wilson's petrels proved to belong to a new species, which is described by Miss T. Clay as *Naubates robertsi* in her report on the Anoplura.

There are seventeen living species of penguins, which Dr. Roberts arranges in six families, one for each genus, except that the Adélie penguin is put in the same family as *Pygoscelis*. The present account has special reference to the Gentoo penguin, *Pygoscelis papua*, and gives a minutely detailed account, with many illustrations.

The author concludes that "each characteristic behavior phase appears to have little meaning unless considered in relation to its place in the cycle as a whole. There is a chain of stereotyped behavior acts correlated with physiological processes which are all closely related to each other. Bird behavior must surely be explained partly in physiological and partly in psychological terms, for endless difficulties arise through investigating by either method alone." All of which may be applied to other creatures than birds.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

SCIENTIFIC BOOKS

HARMONIC INTEGRALS

The Theory and Applications of Harmonic Integrals. By W. V. D. HODGE. ix + 281 pp. Cambridge, England: Cambridge University Press; New York: Macmillan Company. 1941. $4.50.

THE author of this monograph is one of the outstanding geometers in England, and in his special field—algebraic geometry—he is known, above all, for his important contributions to the theory of algebraic integrals attached to an algebraic variety (*abelian integrals*). This theory, inaugurated by the classical investigations of Abel and Riemann on the integrals attached to an algebraic curve (1826, 1857) has been ever since the object of intensive study by analysts and geometers alike (Poincaré, Picard, Castelnuovo, Enriques, Severi, etc.) who were attracted to it either by its profound analytical content or by its power as a tool for the discovery of geometric properties of algebraic varieties. The theory gives rise to many difficult questions, and the difficulties increase with the dimension of the variety. Thus, while the theory of abelian integrals is almost a finished chapter in the case of algebraic curves and is a richly developed chapter also in the case of algebraic surfaces, it is on the whole unexplored territory in the case of varieties of higher dimension. The unsolved problems in which it abounds have to do mainly with the *classification* of the abelian integrals according to their singularities and with the properties of their *periods*. By the period of a *multiple*, say *m-fold*, abelian integral is meant its value which we obtain by integrating along an m-dimensional *cycle* of the variety (cycle = a closed m-dimensional region; a closed curve, if m = 1; a closed surface, if m = 2; etc.).

A typical and important problem, which remained unsolved for a long time, was the following: do there exist integrals which have no singularities and whose periods are all zero? Hodge was the first to prove that such integrals do not exist. This proof marks the beginning of a long series of investigations by Hodge which have materially contributed to a new and substantial progress of the theory of abelian integrals. One of the most significant aspects of these investigations is the diversity of the methods used. In addition to the purely analytical and algebro-geometric methods, topology and differential geometry come effectively into play.

Topological methods, already used by Poincaré in questions of the theory of algebraic surfaces, have been developed in this country by Lefschetz. The topological point of view in algebraic geometry plays an essential role in Hodge's solution of the problem mentioned above. Topology also forms the basis of de Rham's theory of integrals on arbitrary topological manifolds, a theory which is in close connection with Hodge's theory of harmonic integrals.

However, it is the adaptation of the methods and ideas of differential geometry (Riemannian geometry) to the theory of abelian integrals that best reveals the originality of Hodge's theory. Here the central concept is that of a *harmonic integral*. This is not the place to discuss this concept in any detail. It will suffice to say that the concept of a harmonic integral is more general than that of an abelian integral, but is more concrete than the concept of an integral attached to an arbitrary topological manifold. The fruitfulness of the concept of a harmonic integral lies perhaps just in its being a "harmonious" mixture of the right amounts of generality and concreteness.

The mathematical reader will find in Hodge's monograph a very well-written and highly stimulating account of a young and active mathematical theory. He will find ample evidence of the diversity of methods which we have mentioned above. As an ingenious blend of algebraic geometry, analysis, topology, tensor calculus and differential geometry, the monograph should prove of considerable interest to specialists in these various fields.

OSCAR ZARISKI

THE JOHNS HOPKINS UNIVERSITY

ELECTRICITY AND MAGNETISM

A Textbook in Electricity and Magnetism. By H. C. KELLY. vi + 356 pages. New York: John Wiley and Sons, Inc. 1941. $3.75.

THIS elementary text attempts to give the reader an acquaintance with a great deal of modern physics as well as to cover the conventional topics suggested by its title. The twenty-eight chapters are short and emphasize the historical and descriptive aspects of the subject. The diagrams are numerous and well drawn, and a number of simple problems are placed at the end of each chapter. In the third chapter the author goes to some pains to find the potential due to a point mass without the use of the calculus, but does not hesitate to introduce integration by the time Chapter 7 is reached, and to discuss the partial differential equations of the electromagnetic field and the wave equation in Chapter 28. In discussing induced electromotive forces the author makes the common mistake of attributing the e.m.f. to "*relative* motion between a wire and a magnetic field."

The book should prove very useful in a survey course intended to cover modern developments in physics as well as the elements of electromagnetism. To cite a few of the modern topics presented, we find mention of superconductivity, the Barkhausen effect, the Stern-Gerlach experiment, the cyclotron and the electron microscope, and discussions of space-charge, the photo-electric effect, the Bohr theory and the mass spectrograph.

L. P.

HYDROBIOLOGY

A Symposium on Hydrobiology. By JAMES G. NEEDHAM and 51 other contributors. ix + 405 pages. Madison: University of Wisconsin Press. 1941. Price $3.50.

THIS book contains the 32 formal papers presented at a symposium on hydrobiology held at the University of Wisconsin on September 4–6, 1940, and the abstracts of 16 volunteer papers given at one of the sessions. The various contributions cover a wide variety of hydrobiological subjects relating to inland waters, including not only the biological aspects but also the geological, physical, chemical and sanitary phases of this field of science.

The limnological papers deal with the sediments of natural and artificial lakes, the penetration of solar radiation into natural water, dissolved oxygen and lake types, aquatic bacteria in relation to the cycle of organic matter in lakes, trematode parasites of fresh-water snails, the rôle of aquatic fungi in hydrobiology, the limnological rôle of the higher plants, the photosynthesis of algae, the relation of hydrological conditions to speciation in fishes, the age and growth of fresh-water fishes, the fish production of inland lakes and streams, pond fish farming and the effect of pollution on fish life.

The sanitary contributions relate to swimming pool sanitation, water-borne diseases, the chemical treatment of lakes, the food economy of certain mosquito larvae, the relation of hydrobiology to malaria control, the significance of plankton in relation to the sanitary condition of streams, schistosome dermatitis and its control, the microbiology of sewage and sewage treatment and the biochemical relations in the activated sludge process of sewage treatment.

Most of the contributions carry illustrations and include generous bibliographies.

CHANCEY JUDAY

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REPORTS

THE OUTLOOK FOR EDUCATION[1]

A RISING public anxiety respecting the economic difficulties of the after-war period is shared by all our institutions, public and private. Colleges and universities are expected to find their income greatly decreased. Will fewer and fewer students be enrolled as the private incomes of parents shrink in a post-war period of deflation? Will some institutions have to be closed? Will federal support be required for continuation and is it desirable to receive or solicit it? Will the individual members of our faculties come to be as meanly supported as those of continental Europe in the two decades following 1918? Will courses of study tend to become narrowly "practical"?

I believe there are American-style answers to be made to these timorous questions. The post-war period may witness surprisingly great industrial and commercial expansion to satisfy enormous reconstruction and delayed consumption requirements. It is too early to prophesy doom and it is a grave disservice to assume it. In any event we have a sound pioneer tradition in education whose hall-mark is democratic *experiment.* Whatever we may have borrowed from Europe in ideas, materials and techniques, we can trace definite lines of experimentation directed down the years toward our own conditions. The first of these conditions is that education must be adapted to a democratic way of life. Our educational system did not become inclusive by accident. It did not expand by accident. It was an indispensable part of the avowed design of America in the colonial period and still more emphatically at the beginning of our national life. The bulwark of democracy was to be an educated electorate. We are absolutely committed to that course. An illiterate people will not and can not be united. Our union, to be either effective or free, must rest on understanding, and as "no one can know it all or miss it wholly," discussion and compromise are indispensable. Education to know America, to know its history, its social life, its industrial expansion, its artistic and literary creations, its scientific achievements, its power to work together on so vast a scale and at so high a level of efficiency—all this, and all our defects and colossal shortcomings as well—make an educational program that the American public, in our opinion, will sustain. The after-war period will require, as earlier periods of crisis have required, that our cultural institutions keep asking and attempting to answer the question, "How do we want to live in America?" This is the question and the experiment that unites us. There are two deadly dangers in education, the unquestioning acceptance of routine in teaching, and complacency with respect to existing standards and objectives of research. The spirit that maketh alive is compounded in part of free inquiry and controlled experiment; in part also of a high dissatisfaction with the limits of yesterday's horizon.

After this war is ended, whether or not we participate, America will not be like any other country in the world. It will still have more mechanical and electrical power per person by several hundred per cent., it will have its commitments to democracy and inter-group habits of cooperation, there will still be private property and private incomes, there will be a characteristically American outlook in which enterprise, hope and hard work will be blended.

More advanced experimentation will probably mark our educational policies in the post-war years. How can we deepen the study, within the university, of great human problems whose solution is the surest guarantee of the future unity and freedom of America? It is the crowning distinction of the American university that it has built a worthy part of the national temple. While there may be confusion in confused minds concerning university purpose, could anything be clearer than that free inquiry and report is itself one of the greatest and most highly moral educational purposes in a democracy? The university is not designed to be authoritarian and say the last word in morals, ideas, research or teaching. We can avoid the authoritarian road only by choosing the free road. A body of prescribed doctrine, approved books, dialectical smartness and *a priori* opinion masquerading as "wisdom" can give "unity" also, as authoritarian governments have amply demonstrated. The strength of our American unity is in our free way of uniting. Our purpose is to train that freedom into responsibility. The growth of our educational program is due to the demonstrated need for the trained and responsible men and women we help to produce, with all faults of training and learning fully and freely admitted. In part our directive principles and powers grow out of what we find, in part out of a high court of moral judgment called informed opinion. No earthly device can make all our people wise or infallible in judgment. Wisdom that serves unity and fair social living is not an affair of graven tablets to be memorized, nor yet a delusion based on "ragged notions and babblements," but experience of the individual with the world after some thought about human experiences as recorded in the books by minds that are trained to be critical. "Scientific method" is one of several ways by which such training may be developed. We are not far enough advanced biologically to get assured wisdom at 21, as a result of some final scheme of formal education that has so far eluded us according to the critics.

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[1] From the annual report of Dr. Isaiah Bowman, president of the Johns Hopkins University.

SPECIAL ARTICLES

PYRIDOXINE AS A GROWTH FACTOR FOR GRAPHIUM

PYRIDOXINE (vitamin B_6) is known to be essential for the growth of excised plant roots,[1, 2] for certain mutant strains of *Neurospora*,[3] and for the G.M. strain of yeast.[4] In connection with our studies on the vitamin requirements of fungi, an interesting example of pyridoxine deficiency has been found in cultures of *Graphium ulmi*, the organism which causes Dutch elm disease. This preliminary report on *Graphium* presents an example of the requirement of an accessory growth factor necessary for the life of a parasitic fungus. In view of recent work on chemotherapy by use of analogs which compete with natural growth factors in certain microorganisms causing diseases, it is hoped that this information may be of some use to phytopathologists who are attempting to control the Dutch elm disease.

The basal solution used for cultivating *Graphium* contained the following in one liter of triple distilled water: recrystallized asparagine, 4.0 gm; dextrose, 40 gm; KH_2PO_4, 1.5 gm; $MgSO_4 \cdot 7H_2O$, 0.5 gm; $CaCl_2 \cdot 2H_2O$, 0.1 gm. The elements, B, Mn, Zn, Cu, Mo and Fe were supplied in appropriately small quantities. Vitamins were added to this medium in the following amounts per liter: thiamin, 300γ; lactoflavin, 100γ; nicotinic acid, 500γ; pyridoxine, 200γ; inositol, 500γ; pantothen, 200γ; biotin, 0.4γ; and ascorbic acid, 500γ. The medium was dispensed into pyrex flasks, 25 ml per flask, and autoclaved at 15 pounds for 20 minutes. Inoculation was accomplished with bacteriological precautions by pipetting a drop of spore suspension into each flask. Growth was determined at the end of two weeks by weighing the washed and dried mycelium on filter paper.

A typical experiment was set up with basal medium to which no vitamins were added, basal medium containing the 8 vitamins, and a series of media in which one vitamin was omitted at a time to give 8 kinds of single deficiencies. Five replications were employed for each kind of medium. Growth was obvious only in the media containing pyridoxine. The presence or absence of the other accessory substances made little difference in growth. In another experiment each of the 8 vitamins was added singly to the basal medium in order to determine the effectiveness of each in the absence of the other 7 accessory factors. Growth occurred only in the medium which contained pyridoxine. It appears that *Graphium* is able to grow in the basal medium supplemented with only pyridoxine. Either these other vitamins are not essential, or what is more likely, the fungus synthesizes out of elementary compounds other factors which are necessary for growth.

TABLE 1

Pyridoxine gamma/liter	Dry weight of *Graphium* mg/flask
0.005	0.2
0.01	0.3
0.1	1.5
1.0	4.5
50.0	14.2
500.0	13.5

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[1] W. J. Robbins and M. B. Schmidt, *Proc. Nat. Acad. Sci., U. S. A.*, 25: 1, 1938.

[2] J. Bonner, *Amer. Jour. Bot.*, 27: 692, 1940.

[3] G. W. Beadle and E. L. Tatum, *Proc. Nat. Acad. Sci., U. S. A.*, 27: 499, 1941.

[4] R. J. Williams, R. E. Eakin and J. R. McMahan, University of Texas Publication 4137: 24, 1941.

Further studies on the extent of growth in basal medium supplemented with increasing amounts of pyridoxine gave the results shown in Table 1 expressed as the average dry weight of five flasks for each treatment.

The fungus is sensitive to increments of pyridoxine at least in the range from 0.01 to 50.0 gamma per liter. No claim is made for a complete medium for growth of *Graphium*. Additions of yeast or of dark molasses to the medium containing pyridoxine permits still greater growth of the fungus. It seems probable that other unidentified essential factors may be made by the fungus in less than optimum amounts for growth in this synthetic medium.

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ELECTROPHORESIS OF THE CHLOROPHYLL–PROTEIN COMPLEX

A NUMBER of reports concerning the isolation and purification of a chlorophyll-protein complex from leaves have recently appeared. Although the protein nature of the material composing the complex has been supported by analytical evidence, it seemed desirable to investigate the problem by means of electrophoresis in an attempt to demonstrate the existence of an isoelectric point in the range of pH characteristic of proteins.

In 1912 it was observed by Herlitzka,[1] on subjecting press juice of leaves to electrophoresis, that the chlorophyll migrated toward the anode. More recently, Neisch[2] has reported that suspensions of chloroplast granules isolated from clover leaves are electrophoretically negative in distilled water and positive in N/5 HCl. Aside from these reports, there seems to be no information in the literature concerning the electrophoresis of the purified chlorophyll-protein complex.

We have prepared suspensions of the complex by a modification of the methods of Menke[3] and of Stoll and Wiedemann.[4] Young leaves of beans (*Phaseolus vulgaris* L., var. white navy) were ground in M/100 phosphate buffers at pH 7.2 and the deep green suspension was centrifuged to remove cellular debris. Neutralized ammonium sulfate was added to the supernatant solution until the molarity reached 1.3. After a wait of thirty minutes the green material was sedimented by centrifugation; this left the brown impurities dissolved in the supernatant. The operation of resuspension in the buffer and subsequent salting out was repeated several times in the course of several hours. The green material was finally resuspended in the buffer and dialyzed against the same buffer until free from sulfate. All preparative operations were carried out at 0° C. The purified green suspensions exhibited the physical characteristics described by other workers,[4, 5, 6] *e.g.*, a strong maximum absorption band at about 678 mμ, photostability, red fluorescence, sensitivity to protein coagulants. When the pH was reduced below 5, flocculation ensued.

Using a microelectrophoresis technique which has been described elsewhere,[7] we have found that the green microscopic particles, which make up the suspensions, are isoelectric at pH 4.7 in M/50 acetate buffers at 25° C. The particles migrate independent of size, shape or degree of clumping. Particles at the limits of microscopic visibility (at a magnification of 1,100) migrated at the same rate as larger ones. In fact, the particles behaved as though their surfaces were exceedingly uniform. By centrifugation at about 4,000 r.p.m. it was possible to remove all visible particles. Quartz or collodion particles placed in the resultant clear green solutions exhibited an electrophoretic behavior identical, within the limits of error, with the natural chlorophyll-containing particles of the original suspensions. No significant differences could be noticed between the electric mobilities of various preparations. Under the above ionic conditions the electric mobility curve tends to flatten out on the negative side at about pH 6.5 and on the positive side at about pH 3.6.

Smith[6] reports that suspensions flocculated at pH 4.5 or below are altered by the acid and more readily salted out after resuspension. We have found that particles from suspensions exposed to a pH of 3.1 (M/25 acetic acid) for more than thirty minutes exhibit an altered electric mobility when resuspended in more basic buffers. The electric mobility curve is shifted so that the isoelectric point lies at pH 5.0. The curves are nearly parallel on the negative side but converge on the positive side. Investigations of the rate of this denaturation process show that it is virtually complete within five to ten minutes at pH 3.1 (at 25°). At values of pH more basic than 3.1, the process is less rapid. Since at least five minutes are needed to make a measurement of electric mobility, it is apparent that the electric mobility of the undenatured material can not readily be determined below pH 4.5. In this respect the particles are similar to thyroglobulin in their behavior.[8]

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[1] A. Herlitzka, *Biochem. Z.*, 38: 321, 1912.

[2] A. C. Neisch, *Biochem. Jour.*, 33: 293, 1939.

[3] W. Menke, *Z. Bot.*, 32: 273, 1938.

[4] A. Stoll and E. Wiedemann, *Fortschr. Chem. organ. Naturstoffe*, 1: 159, 1938.

[5] J. Shafer, SCIENCE, 91: 580, 1940.

[6] E. L. Smith, *Jour. Gen. Physiol.*, 24: 565, 1941.

[7] L. S. Moyer, *Jour. Bact.*, 31: 531, 1936.

[8] M. Heidelberger and K. O. Pedersen, *Jour. Gen. Physiol.*, 19: 95, 1935.

It would seem premature to assert that these observations characterize the chlorophyll-protein itself. In any event, the electrophoretic properties are closely correlated with the general colloidal behavior of the complex. We intend to publish an extended account of these investigations in the near future.

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EFFECTS OF OXYGEN ON RESPIRATION, FERMENTATION AND GROWTH IN WHEAT AND RICE

RICE seeds are capable of germinating in the absence of oxygen and the seedlings grow well when submerged in water containing little oxygen, whereas wheat is unable to germinate or develop under such conditions.[1] In an attempt to ascertain the physiological basis for this difference, a study was made of the influence of variations in oxygen tension (pO_2), from 0 to 20.8 per cent., on respiration, fermentation and growth in seedlings of each of these cereal grains.

Manometric measurements of the gas exchanges occurring in seedlings of wheat (*Triticum vulgare* var. Leap's Prolific) and of rice (*Oryza sativa* var. Early Prolific) were conducted at 30° C., using a Barcroft-Warburg apparatus according to the method of Dickens and Simer.[2] The seedlings had roots 5 to 8 mm long when germinated in the dark at 30° C. on moist filter paper; for this development wheat required 24 to 26 hours, rice 30 to 33 hours. Groups of uniform seedlings (25 wheat or 30 rice) were soaked for one hour in a 0.013 molar phosphate buffer adjusted to pH 5.8, containing 4 per cent. sucrose and having a K/Ca balance of 7.5/1. Then the seedlings of each group were placed on a bed of glass beads in the manometer vessel with their roots submerged in the buffer solution to a depth of 1 to 2 mm. Prior to each test of 1 to 1.5 hours' duration, the vessels were thoroughly flushed with the required gas mixture, prepared by partially replacing normal air with nitrogen.

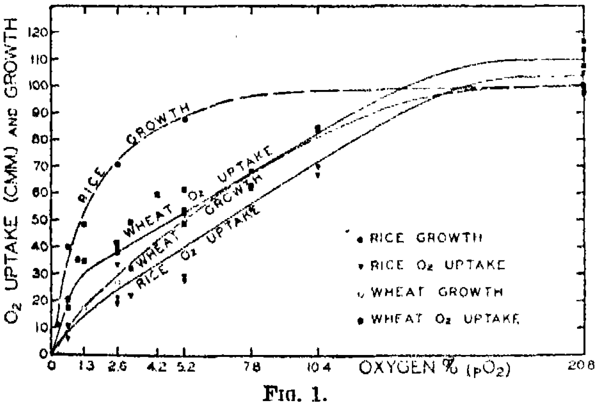

FIG. 1.

The results of the gas-exchange measurements are shown in Figs. 1 and 2, in which smoothed curves have been drawn in solid lines to show the trend of the experimentally determined points, each of which represents the average of 4 or 5 separate determinations. In 20.8 per cent. O_2 (air) the average activity of rice seedlings, as shown by CO_2 evolution, was found to be 87 per cent. of the average of wheat seedlings on the basis of dry weight of embryos. To facilitate comparison of the experimental data, the curves in all cases have been plotted for the activity of a number of seedlings (wheat, 6.4; rice, 13.3) calculated to produce 100 cmm of CO_2 per hour in 20.8 per cent. O_2.

In the growth experiments 225 twelve-hour-old seedlings of wheat and rice were allowed to develop for 96 hours at 30° C. on moist filter paper in gas streams containing from 0.25 to 20.8 per cent. O_2. Increment in dry weight of embryo (*i.e.*, of all the seedling except the endosperm) was used as a measure of growth. The curves depicting the results of the growth experiments are presented in Fig. 1, plotted on a scale of ordinates in which 100 represents the increment in embryo dry weight in 20.8 per cent. O_2.

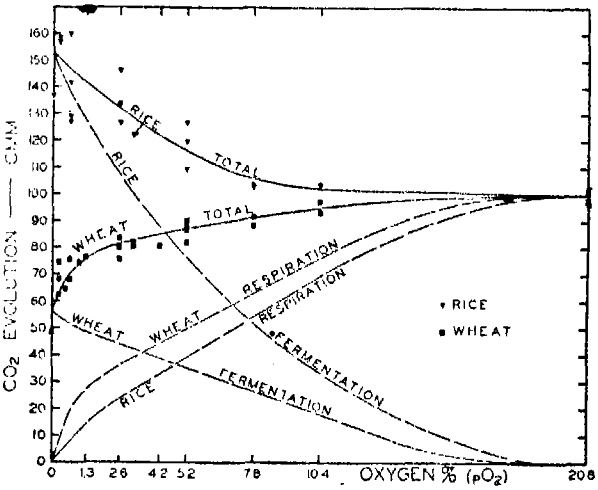

FIG. 2.

Inspection of the curves of Fig. 1 for O_2 consumption reveals the following relations: The O_2 intake by rice is less rapid than that by wheat over the range of O_2 tensions in which tests were conducted. With decrease in O_2 tension, the growth curve for wheat falls rapidly, and it roughly parallels the curve for O_2 consumption. In rice the relation is very different: As the O_2 tension is decreased, the growth curve remains relatively high in spite of a rapid and continuous decrease in the O_2 intake.

---

[1] I. Nagai, *Tokyo Imp. Univ. Jour. Coll. Agr.*, 3: 109, 1916. C. Stich, *Flora*, 74: 1, 1891.

[2] M. Dixon, "Manometric Methods," pp. 61–67. London: Cambridge University Press. 1934.

Fig. 2 shows not only total evolution of CO_2, but also its components—respiration CO_2 and fermentation CO_2. In preparing these curves, it was assumed that all the activity of seedlings tested in 20.8 per cent. O_2 (air) was respiration (aerobic) and that in this O_2 tension little or no fermentation (anaerobic) occurred.[3] The respiratory quotient (CO_2/O_2) for activity in air was calculated, and it was assumed that this quotient remained constant for respiration (aerobic) in all O_2 tensions. Knowing the respiratory quotient, and having measured O_2 absorption and CO_2 evolution over the range of O_2 tensions, the amounts of respiration CO_2 and fermentation CO_2 could be calculated for any O_2 tension as follows:

cmm O_2 × respiratory quotient = cmm respiration CO_2.
cmm total CO_2 − cmm respiration CO_2 = cmm fermentation CO_2.

Applying this method to the smoothed curves for total CO_2 (Fig. 2) and O_2 (Fig. 1), the curves shown by broken lines in Fig. 2 were obtained.

From Fig. 2 it may be seen that as the O_2 tension decreases, the experimentally determined curve for total CO_2 output of wheat falls, whereas there is a rise in the corresponding curve for rice. The curves for CO_2 produced in respiration (aerobically) are similar in form to the O_2 activity curves of Fig. 1 from which they were calculated; wheat shows higher respiratory activity than rice. Inspection of the curves of Fig. 2 representing CO_2 produced in fermentation (anaerobically) shows far greater activity in rice than in wheat. As the O_2 tension is decreasing from 10 to 0 per cent., the fermentation in rice increases rapidly, until the CO_2 output by fermentation in 0 per cent. O_2 reaches 150 per cent. of the total CO_2 evolution in air. With the corresponding decrease in O_2 tension the increase in fermentation in wheat is much more gradual, and in the complete absence of O_2 the CO_2 output attains a level only 50 per cent. as high as the total CO_2 output in air.

Approximate I/N ratios (total CO_2 output in $N_2 \div$ total CO_2 output in 20.8 per cent. O_2) for wheat and rice are 0.5 and 1.5, respectively; and Meyerhof quotients[4] for O_2 tensions above 0.25 per cent. are from 1.5 to 2.0 for rice and 0.2 to 0.5 for wheat. Both the I/N ratios and the Meyerhof quotients indicate that a marked Pasteur effect (or O_2 inhibition of fermentative processes) occurs in rice, whereas this effect is relatively weak in wheat. Under the conditions of these experiments the anaerobic mechanism of rice in the complete absence of oxygen is approximately three times as active as that of wheat. With increase in O_2 tension, the values of the F/R ratio (ratio of fermentation to respiration where O_2 is present, 0.25 per cent. or higher) range from 7.3 to 0 for wheat and from 50 to 0 for rice.

We may conclude that in the absence of O_2 rice is capable of germination because it possesses a strong mechanism for fermentation, whereas wheat, with its feebly functioning anaerobic system, is unable to germinate. Even in rice, growth soon ceases in the complete absence of oxygen. With a very low O_2 supply rice is able to accomplish more nearly normal growth than wheat in spite of the fact that rice is less capable than wheat of using the low concentration of O_2 in respiration. The superiority of rice over wheat in ability to grow in a low O_2 concentration is dependent upon the possession by rice of a very strongly developed fermentation (anaerobic) system that more than compensates for a respiration (aerobic) system that is even weaker than that of wheat. It is expected that a more detailed analysis of these data will be published elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS TO DELIVER A MEASURED AMOUNT OF CO_2 FOR BLOOD CULTURES

The importance of blood cultures in the diagnosis of Brucellosis in man necessitates a simple apparatus for providing a CO_2 atmosphere for these cultures. The apparatus described here (Fig. 1) can be made from materials usually stocked in any hospital laboratory.

The CO_2 is drawn from a tank with a reducing valve and conducted through a rubber tube to a three-way valve, and from this to either a hypodermic syringe or a Luer observation tube connected to a 20-gauge, 3-inch hypodermic needle. This needle has been bent and fused to a 20-gauge, 1½-inch needle, which in turn is fastened to another Luer observation tube opening to the outside. The three-way valve may be adjusted so that the barrel of the hypodermic syringe is connected with the tube leading to the longer hypodermic needle.

The three-way valve is first adjusted so that a stream of CO_2 will flush out any air present in the rubber tubing and the 3-inch hypodermic needle. The needles are then inserted through the rubber vaccine stopper into the 250 cc medicine bottle containing 100 cc of medium, and 10 cc of the patient's blood. The valve is then turned so that the CO_2 will flow into the syringe, pushing up the plunger until the required amount is indicated on the barrel. The valve is once more adjusted so that the CO_2 will flow from the barrel of the syringe into the medicine bottle, displacing air which is forced from the bottle through the shorter hypodermic needle.

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[3] D. Burk, Cold Spring Harbor Symposia on Quantitative Biology, 7: 420, 1939.

[4] K. C. Dixon, *Proc. Cambridge Phil. Soc.*, 12: 431, 1937.

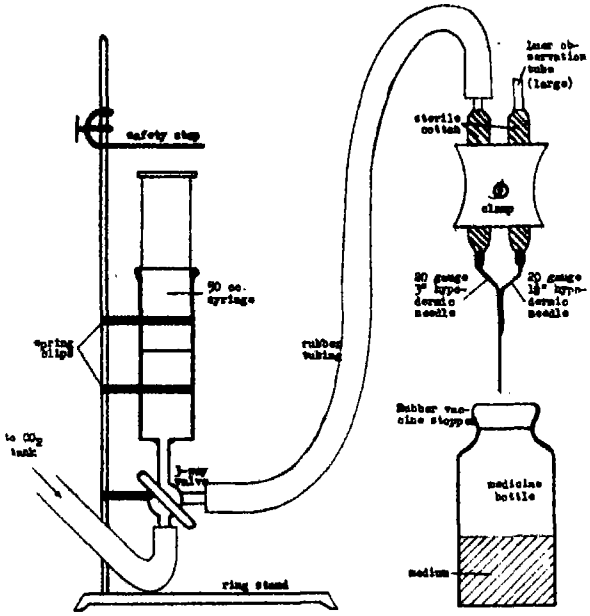

FIG. 1.

The weight of the plunger is sufficient to force the CO_2 out of the syringe if the plunger slides smoothly. Only a smoothly sliding syringe should be used if the volume is to be accurately measured. A safety clamp above the plunger will prevent it from shooting out when the CO_2 pressure becomes greater than the required ½ pound gauge pressure.

The three-way valve may be fused to the syringe or it may be fused to a collar which slips on the syringe. The latter is preferable since syringes of different sizes may then be used. The apparatus can then function in other ways. For example, without the needles, it may be used for conducting a measured amount of O_2 into an anaerobic jar during the preparation of staphylococcus enterotoxin. It may also be used to supply CO_2 to anaerobic jars for the culture of the gonococcus on solid media.

The needles may be sterilized as a unit together with the clamped Luer tubes.

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TRAPPING SNAILS OF THE GENUS CAMPELOMA

AN efficient method of collecting the snail *Campeloma* sp. in streams was found during a study of the life history of the trematode worm *Cercariaeum constantiae* Mueller. Since *Campeloma* habitually burrows, the collection of these snails in quantity by screening consumes much time and is hard work. While collecting these snails in the Huron River near Ann Arbor, Michigan, I noted that they were frequently found in considerable numbers around dead and decaying organic matter. To determine the time required to accumulate a quantity of snails, a dead fish weighing a pound was placed in the mud where earlier collections had been made. Ten days later, an area of approximately one foot square and six inches deep around the fish yielded 78 *Campeloma*, a number far exceeding those taken in similar, but unbaited, situations.

Dr. G. R. La Rue suggested the use of dung in place of dead fish, as he believed that these snails might be coprophagous and become infected by eating trematode eggs voided in feces. Accordingly, small cloth packets of feces were planted in the muck and found to be equally as effective as the dead fish, and more conveniently handled. Dung of dog, cat, ferret, muskrat and chicken was tried. After a few preliminary experiments, chicken dung was used exclusively. It was dried before use, which eliminated objectionable odors and permitted it to be packaged in quantity and stored to be used as needed. Dried dung was as effective as fresh.

To make a snail trap, a quantity of dried chicken dung is placed in the center of a cloth nine inches square, the corners twisted together and tied with heavy cotton twine, leaving free enough to tie to a stake. Double thickness of washed cheesecloth is ideal; heavier cloth resists rotting for a longer time but also retards the passage of the fecal extract. The twine should be capable of resisting rotting in water, since these packets remain effective until their contents are gone. The packets are tied to stakes and placed in suitable habitats for *Campeloma*.

Choice of location is important. In streams these snails frequent shallow, mucky situations and plantings should be made here; gravel areas in deep water should be avoided. When properly planted, the packet should be half-buried in mud with the stake projecting above the water level far enough to be easily recognized. In areas frequented by many people, the plantings should be inconspicuous to prevent possible interference. This can easily be accomplished by using dark-colored cloth and stakes made of tree branches; in summer, willow is especially suitable because the leaves remain green and willow looks natural along the banks of streams.

The trap remains effective for approximately six weeks, but to get best results the location should be changed every ten days or two weeks. The snails are collected by removing the trap and screening the mud from an area about 15 inches square around it by means of a wire net (Fig. 1). The net consists of a frame of one quarter inch steel bar fashioned in the shape of an equilateral triangle one foot on a side, and having a tang three inches long at the apex mounted in a handle with a ferrule. Galvanized wire screen of three sixteenths inch mesh is soldered to the frame. The screen gradually deepens from the leading edge to form a bag two inches deep at the apex of the triangle. The leading edge is protected by a band of galvanized sheet iron three inches wide folded over the frame and soldered. The completed screen is very sturdy and will withstand hard usage.

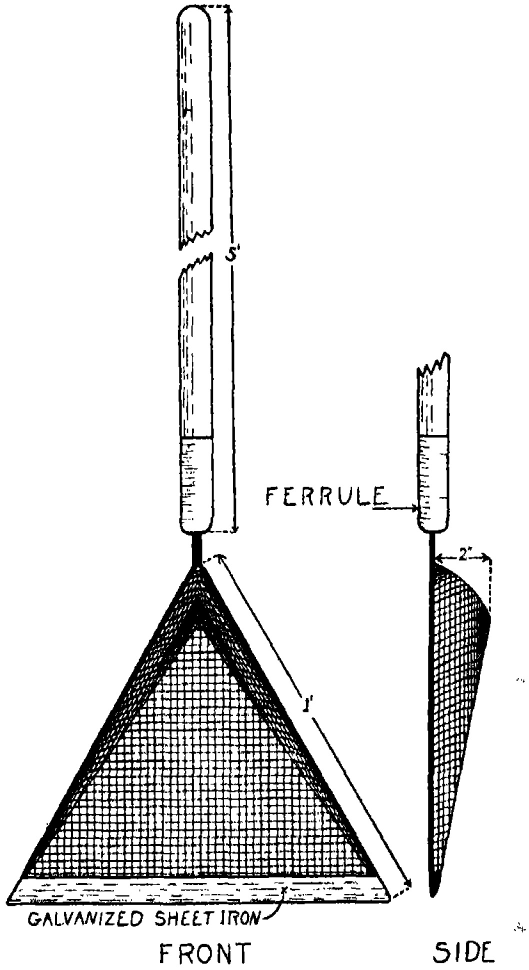

FIG. 1. Front and side view of collecting net.

It was suspected that in streams the current might carry the fecal extract which the snails followed to its source at the trap. This idea was tested by planting marked snails at various distances, two to 15 feet, upstream, as far as 20 feet downstream, and ten feet across the stream from a trap. In collections made at weekly intervals for five weeks, 28 of the 67 snails (41.7 per cent.) planted upstream, 24 of the 86 (26.7 per cent.) planted downstream, and 2 of the 9 (22.2 per cent.) planted across the stream were taken at the trap. Practically the same number of snails moved to the trap from 15 feet upstream and 20 feet downstream as from 2 feet up- and downstream. My data indicate that the snails move at random. Once arrived at the trap, however, they tend to stay as long as the food supply lasts.

In lakes the traps proved ineffective. Experiments to determine the reason for this have not been carried out. All the lakes tried had bottoms of sand underlaid by muck which perhaps provides sufficient food for *Campeloma* to nullify the effects of food concentrated at traps. Traps should be tried in lakes with clean, sandy bottoms.

In the streams tested the traps are specific for *Campeloma*. Other species of snails are not taken in the traps and only occasional bivalves, *Alasmidonta calceolus* and *Sphaerium* sp., have been collected from them.

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BOOKS RECEIVED

BARBER, HERVEY H. and T. IVAN TAYLOR. *Semimicro Qualitative Analysis.* Pp. xvi + 446. Harper. $3.50.

DAVIS, HAROLD T. *The Analysis of Economic Time Series.* Monograph No. 6, The Cowles Commission for Research in Economics. Pp. xiv + 620. Principia Press.

DRAPER, GLEN HILDING. *What Is Truth?* Pp. 122. Ransdell, Inc.

FREEMAN, WALTER and JAMES W. WATTS. *Psychosurgery.* Illustrated. Pp. 237. Charles C. Thomas. $6.00.

GILMAN, HENRY. *Organic Syntheses.* Collective Volume 1, Revised edition. Pp. xi + 580. John Wiley. $6.00.

GREEN, S. L. *Algebraic Solid Geometry.* Pp. 132. Cambridge University Press. $1.75.

NIEDERL, JOSEPH B. and VICTOR NIEDERL. *Micromethods of Quantitative Organic Analysis.* Second edition. Pp. xiii + 347. John Wiley. $3.50.

PALMER, W. G. *Experimental Physical Chemistry.* Pp. xi + 321. Cambridge University Press. $2.75.

SINGER, CHARLES. *A Short History of Science.* Pp. xiv + 399. Oxford University Press. $3.00.

Standard Plant Names. Prepared by the editorial committee, HARLAND P. KELSEY, chairman of the American Joint Committee on Horticultural Nomenclature. Second edition. Pp. xv + 675. J. Horace McFarland Co. $2.50.

STAUFFER, CLINTON R. and GEORGE A. THIEL. *The Paleozoic and Related Rocks of Southeastern Minnesota.* Bulletin 29, University of Minnesota, Minnesota Geological Survey. Illustrated. Pp. viii + 261. University of Minnesota Press. $4.00.

WENDT, GERALD. *Chemistry.* Volume in *The Sciences*, A Survey Course for Colleges. GERALD WENDT, editor. Pp. viii + 300. John Wiley. $1.75.

SPECIAL ISSUE CONTAINING REPORTS OF THE DALLAS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

SCIENCE

Vol. 95 FRIDAY, FEBRUARY 6, 1942 No. 2458

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THE ONE HUNDRED AND TENTH MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND AFFILIATED AND ASSOCIATED SOCIETIES

Edited by Dr. F. R. **MOULTON**

PERMANENT SECRETARY

From December 29, 1941, to January 3, 1942, the American Association for the Advancement of Science held its annual meeting in Dallas, Texas. When the meeting was originally planned the officers of the association looked forward with pleasure to going to Texas, but their happy anticipations were clouded by the turn of international affairs early in December. Their misgivings, however, were not well founded, for the meeting surpassed all expectations. The programs of the association and its affiliated societies included 1,436 addresses and papers which were presented at 193 different sessions. About 4,000 persons attended the scientific sessions, of whom 1,851 registered and received the general program of the meeting.

In 1931–1932 the association held its annual meeting in New Orleans, a much larger city than Dallas and one nearer the great centers of population. At the New Orleans meeting a decade ago and in time of peace the registration was 1,447, less than the registration at Dallas by 404, and the number of addresses and papers presented was 1,263, or 173 fewer than were presented at Dallas. This favorable comparison is due in part to the present vigor of the association and its affiliated societies and in part to the enthusiastic support of the Dallas meeting by the citizens of Texas, which was expressed in the excellent local arrangements and the exceptionally large attendance at the general addresses open to the public.

REGISTRATION

The registration for the meeting at Dallas by states and foreign countries was as follows: Alabama, 15; Arizona, 14; Arkansas, 23; California, 68; Colorado, 29; Connecticut, 17; District of Columbia, 30; Florida, 7; Georgia, 14; Hawaii, 1; Illinois, 79; Indiana, 44; Iowa, 60; Kansas, 51; Kentucky, 10; Louisiana, 84; Maine, 1; Maryland, 14; Massachusetts, 17; Michigan, 36; Minnesota, 34; Mississippi, 17; Missouri, 60; Montana, 3; Nebraska, 28; Nevada, 1; New Hampshire, 3; New Jersey, 14; New Mexico, 33; New York, 67; North Carolina, 17; North Dakota, 5; Ohio, 58; Oklahoma, 126; Oregon, 4; Pennsylvania, 29; Rhode Island, 4; South Carolina, 9; South Dakota, 5; Tennessee, 21; Texas (Dallas, 134), 621; Utah, 3; Vermont, 1; Virginia, 18; Washington, 4; West Virginia, 5; Wisconsin, 32; Wyoming, 6; foreign countries, 9 (Argentina, 1; Brazil, 2; Canada, 6); a total of 1,851.

ARTHUR H. COMPTON, PRESIDENT-ELECT

Dr. Arthur H. Compton, Charles H. Swift Distinguished Service Professor of Physics in The University of Chicago and Dean of the Division of Physical Science, was unanimously elected president of the association by the council at its meeting held on Dec. 31, 1941. In electing Dr. Compton the council agreed with the general membership of the association which favored him for president in the preference ballot cast in October and November.

It is unnecessary to list the honors Dr. Compton has received, for they are widely known in a general way but are too numerous to be remembered by any one, even by himself. He has been honored for the profound researches he has carried out in the quiet and solitude of his laboratory, for his scientific statesmanship (if the word may be borrowed for use in this connection) in organizing and carrying out worldwide investigations of the reception and properties of cosmic rays, and for the influence he has had on education. In choosing as its president a man so highly honored in foreign countries, as well as in his own, the association adds another illustrious name to the roll of its presidents.

Dr. Compton is a member of a family that has become famous in one generation, his brother, Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, having been president of the association in 1935, and his brother, Dr. Wilson Compton, having been a member of the finance committee of the association from 1933 to 1941. Dr. Arthur H. Compton was born in Wooster, Ohio, 49 years ago, son of a college professor of philosophy and of a mother noted for her intelligence, ability and character. He was graduated from Wooster College in 1913, took his Ph.D. degree at Princeton University in 1916, and he has received honorary degrees from several universities. He has been on the faculty of Wooster College, Princeton University, the University of Minnesota, Washington University, and finally in the department of physics of The University of Chicago since 1923. Dr. Compton has had in addition the broadening experiences of being a research physicist of the Westinghouse Lamp Company in 1917–1919, a national research fellow at Cambridge, England, in 1919–1920 and special lecturer at several foreign universities.

Those who do not know Dr. Compton personally naturally wonder what sort of man he is as a human being. Contrary to the cartoonist's conception of a scientist, he was a football player in college and has kept his robust physique, he is not absent-minded or a dreamer but an excellent companion with a great variety of interests, and as a member of society he is a model of stability and integrity. Nor is he lacking in appreciation of the fine arts or of the aspirations that move us in quiet hours. He is, in fact, one of the most sincere supporters among scientists of the value of religion for humanity. Of such a sort is the man whom the association has chosen as its leader at the time of its greatest membership and of its greatest opportunities for service to science and society.

THE ASSOCIATION PRIZE AWARD

A generous friend of the association has provided a Thousand Dollar Prize to be awarded at each annual meeting for a paper of high importance presented before a scientific session. Since the relative importance of scientific work in different fields can not be determined, there can be no "best paper" at a meeting of the association. There can be and are many papers of high importance, a fact that makes the work of the prize committee difficult.

The nineteenth Thousand Dollar Prize was unanimously awarded at the meeting in Dallas to Drs. Dugald E. S. Brown and Douglas A. Marsland, of New York University, and Dr. Frank H. Johnson, of Princeton University, for two joint papers, referring to two aspects of the same broad problem, the titles of which are given in the following report of the prize committee. The report of the prize committee, consisting of Frank E. E. Germann (chemist), chair-

man, John A. McGeoch (psychologist), Hugh D. Miser (geologist), Theophilus S. Painter (zoologist) and Malcolm H. Soule (bacteriologist) was as follows:

> The Committee on the Thousand Dollar Prize Award has been greatly impressed by the large number of papers presenting the results of pure and applied research which have been read at the 110th meeting of the American Association for the Advancement of Science, held in Dallas.
>
> We unanimously vote to award the Thousand Dollar Prize for the two closely related papers presented as one: (1) "The Reversible Denaturation of Enzymes as a Determining Factor in the Reaction of Biological Systems to Temperature and Pressure." (2) "The Mechanism of Temperature and Hydrostatic Pressure Reversal of Narcosis in Luminous Bacteria," by Drs. Dugald E. S. Brown and Douglas A. Marsland, of New York University, and Frank H. Johnson, of Princeton University.
>
> In these papers an interpretation for the reversible biological effects of pressure is presented and the quantitative evidence seems to be fully conclusive and is directly referable to basic principles of thermodynamics.
>
> In solving the riddle of pressure, evidence has been found for a new general understanding of temperature relations in biological processes. A new concept, also supported by clear-cut evidence, is introduced with regard to the mechanism of narcosis.
>
> Thus a common denominator appears to have been found for three fundamental factors in biological processes—pressure, temperature and narcosis—wherein diverse effects can now be related to the same fundamental mechanism, itself in accord with familiar laws of physical chemistry.

Dr. Brown was born in St. Thomas, Ontario, in 1901, and took his college work at the University of Michigan and received the Ph.D. degree from Cornell University. Dr. Marsland was born in Brooklyn in 1899 and received the B.S. and Ph.D. degrees from New York University and the M.S. degree from Columbia University. Dr. Johnson was born in Raleigh, N. C., in 1908 and received the A.B. and Ph.D. degrees from Princeton University and the A.M. degree from Duke University.

RESOLUTION OF APPRECIATION

(*Unanimously passed by the Council Dec. 31, 1941*)

"For the first time in the history of the A.A.A.S. the great state of Texas has been its host for an annual meeting. Texas was admitted as a state at about the same time the Association was organized, the state having been taken into the Union in 1845 and the A.A.A.S having been organized in 1848. Both Texas and the Association have surpassed the highest expectations of their founders. Texas is an empire, not only in the extent and variety of its area, but in its natural resources, its agriculture, industry, commerce and wealth; and now in its education, its culture, its ambitions and in all the finer aspects of civilization. It has been a distinct pleasure for this Association, one of the greatest scientific associations of the world, to hold its 110th meeting in one of the several outstanding cities of this state.

"Now that the meeting has exceeded all expectations in attendance, quality of papers and local interest, the Council of the Association, at its final session, held in Dallas on this, the last day of the year 1941, records its deep appreciation for the efficient services rendered by the Dallas Local Committee, organized under the chairmanship of Dr. W. E. Wrather, and for the unfailing support of the Southern Methodist University, and of all other cultural and educational institutions of Texas, for the hearty and effective cooperation of the many Texas scientific organizations, for the generous, abundant and intelligent support of the local press, for the facilities provided by local institutions and organizations, and most of all, for the cordial welcome extended by Texas citizens in general.

"In this environment and supported by Southwestern hospitality, the scientists for a brief period have turned aside from the grievous turmoils of the world and have concerned themselves with matters of great importance in the long run of human interest and welfare.

"For the generous hospitality bestowed and for efficient assistance received in holding a great meeting during critical times, the American Association for the Advancement of Science here records its grateful thanks to the citizens of Texas."

THE PRESS

(*From report by Sidney Negus, director*)

Of the 1,423 titles of addresses and papers listed in the program of the meeting, 382 were received in full or in abstract form in time to make them available for the use of the Press in Dallas. With their usual acumen the science writers discovered what papers were regarded as important by the scientists themselves, as well as those that lent themselves readily to interesting news stories. The members of the National Association of Science Writers sent out daily thousands of words about the meeting that were used widely by leading daily papers throughout the United States; and representatives of Texas papers made the meetings one of the principal news items of the week. This happened at a time when the papers were crowded with war news from all over the world.

THE ACADEMY CONFERENCE

(*From report by V. Earl Light, secretary*)

The fifteenth annual Academy Conference was held on the afternoon of December 29 with 21 representatives of affiliated academies, 2 members of the executive committee of the association and 4 visitors in attendance. The formal program consisted of "A Résumé of A.A.A.S. Research Grants" made by affiliated academies, by E. C. Faust, of the New Orleans Academy, and a paper on "The Organization of a Collegiate Division of the Texas Academy of Science," by J. C. Godbey. Dr. Faust brought out (a) that in making grants for research the academy as a rule adds very little to the funds supplied by the association; (b) that there is little evidence that the research projects reach the publication stage except as abstracts in academy transactions; and (c) with few exceptions, the secretaries of the academies have difficulties in obtaining progress reports from grantees. It was recommended that the academies consider restricting grants to persons who would furnish annual progress reports, that the secretaries and grants committees of the academies cooperate in keeping duplicate and continuing files of all grants made since 1935, and the reports clear through the office of the permanent secretary of the association.

Dr. Godbey reported any science club or society in any college or university of Texas having 10 or more student members, at least 5 of whom are members of the Texas Academy of Science, is eligible for membership in the Collegiate Division of the Academy and is designated as a chapter. Each chapter is entitled to an official delegate for each 10 members to the annual meeting which is held concurrently with the annual meeting of the academy. Each student member of a chapter who is a member of the academy pays an annual membership fee of $1 to the academy.

At the close of the complimentary dinner provided by the association, E. C. L. Miller resigned as chairman of the Committee on Junior Academy Relationships. A committee, consisting of S. W. Bilsing, G. W. Prescott, F. R. Moulton and Otis W. Caldwell, was authorized to form a committee to study junior academy problems.

THE SECRETARIES CONFERENCE

(*From report by Ernest Carroll Faust, secretary*)

The annual Secretaries Conference was held Dec. 31, following a complimentary dinner by the A.A.A.S. to the secretaries of the sections and of the affiliated and associated societies participating in the meeting. Twenty-eight persons were in attendance, including 6 members of the Executive Committee, the secretary of the Southwestern Division, the director of press service, the secretaries of 12 sections, the secretaries of 6 affiliated societies and 2 guests. Dr. Otis W. Caldwell was chairman of the conference.

First on the program was a report by Dr. B. E. Livingston, of the committee on revision of the constitution, of which he is chairman. He presented the proposed constitution with annotations explaining all important changes from the present constitution. The discussions were spirited and relevant, for no one appreciates better than the secretaries of the sections and of the affiliated societies the administrative problems of the association.

The second part of the program consisted of a symposium on "Science and Human Needs," the first contribution to which was a paper by Dr. M. F. Morgan, secretary of the Section on Agriculture, on "Social and Economic Aspects of Scientific Agriculture in Relation to Human Needs." Among the many interesting things he mentioned was the fact that only 22–30 per cent. of the students in colleges of agriculture go into farming. He also commented on the transition that is rapidly going on in agriculture from individualistic enterprises to a coordinated and even regimented industry. The second participant in this symposium was Dr. Bruce L. Melvin, *secretary pro tem.* of the Section on Social and Economic Sciences, who presented a paper on "The Social Sciences and Human Needs." Both of these papers gave rise to lively discussions.

GENERAL SESSIONS

With the growth of the association and the increase in the number of its affiliated societies its scientific sessions naturally become more numerous and more specialized. Since, at the Dallas meeting, there were 193 different sessions for the delivery of addresses or the presentation of papers, most of which were held in three days, it follows that during a large part of the time many sessions were being held simultaneously. For example, on Tuesday morning 36 sessions were held, requiring of course 36 meeting rooms fully equipped with all the facilities required for holding large scientific meetings.

There were, however, a number of general sessions in which distinguished scholars presented surveys and integrations of broad fields of science and of science in its relations to the problems of living. In these sessions scientists with widely different special interests and the general public met together with the common purpose of broadening their understanding of the physical and biological universes about us and within us.

In conformity with custom, the first general session held on Monday evening was for the presentation of the retiring president's address. After an address of welcome by Dr. Umphrey Lee, president of Southern Methodist University, on behalf of the citizens of Dallas and of Texas, Dr. Irving Langmuir, president of the association, presented Dr. Albert F. Blakeslee, retiring president of the association, who delivered an address on "Individuality and Science." The audience listened to the address with rapt attention and gave clear evidence of their approval at its close. It was published in full in the Jan. 2 issue of SCIENCE.

On Tuesday evening the Society of the Sigma Xi and the association presented the twentieth annual lecture under their joint sponsorship. The lecturer was Dr. Edwin P. Hubble, astronomer of the Mt. Wilson Observatory, who delivered an illustrated address on "The Expanding Universe Theory." Dr. Hubble himself laid the foundation for the theory he discussed by his discovery of the fact that the more distant an exterior galaxy of stars the more the spectral lines of its light are displaced toward the red end of the spectrum. These results were interpreted as proving that the hundred million known galaxies are rapidly receding from one another, which in turn gave rise to the "exploding universe" theory and the conclusion that the universe of galaxies originated about 2,000 million years ago. With admirable clarity Dr. Hubble marshalled the enormous observational evidence relating to the problem which he has secured in the course of years and showed that it is not consistent with the expanding universe theory. His paper will be published in the April *Sigma Xi Quarterly* and in the April number of *The Scientific Monthly.*

The Honor Society of Phi Kappa Phi joined with the association for the third time in sponsoring a lecture by a distinguished speaker at an annual meeting. Last year Dr. Edmund E. Day, president of Cornell University, delivered the address. This year, Dr. Homer P. Rainey, president of the University of Texas, was appropriately the speaker. He chose for his address the challenging subject, "Scholarship is Not Enough." How often when we are thoughtful do we come back to the fact that life is much more than lore!

For seven years the United Chapters of Phi Beta Kappa and the association have joined in sponsoring a lecture that is intended not only to integrate the sciences, natural and social, but to ignore the boundaries that too frequently exist between the sciences and the humanities. This year the address, with Dr. E. L. DeGolyer presiding, was delivered by Dean Christian Gauss, of Princeton University, on "Can We Educate for Democracy?"

STATISTICAL SUMMARY OF PROGRAMS

One of the most valuable features of the meetings of the association and of its affiliated societies is the numerous joint sessions that are held. These joint sessions, however, make it difficult to present a clear picture of the meeting as a whole, including the magnitudes of the programs in the different fields.

The following table is a statistical summary of all the programs, except the general sessions, at which papers were presented. The programs are classified under the subjects covered by the different sections of the association. When a section or a society meets alone the facts respecting its program are clear. In case a section and a society or two societies in the same group meet jointly, the section or the society appearing first in the program is given first in the table and the program is not repeated with the other society appearing first.

When, however, two different sections, or a section and a society in a different section, or two societies in different sections hold a joint session, the program is repeated in both sections. For example, the Section on Geology and Geography (E) and the Section on Anthropology (H) held a joint session which is announced under each section for the obvious reason that to list it under one alone would leave an erroneous impression regarding the extent of the program of the other. For this reason the following summary contains a few duplications.

SECTIONS AND SOCIETIES	SESSIONS	PAPERS
Mathematics		
Section A, Institute of Mathematical Statistics and Econometric Society	2	15
Physics		
Section B and Am. Assoc. of Physics Teachers	4	21
American Meteorological Society	4	16
Section on Chemistry (C)	4	81
Section on Astronomy (D)	5	14
Geology and Geography		
Section E, Geol. Soc. of Am., Texas Acad. of Sci., Dallas Petroleum Geologists and Ft. Worth Geol. Soc.	2	19
Section E, Geol. Soc. of Am. and Am. Geophysical Union	1	8
Section E, Geol. Soc. of Am. and Section on Anthropology	1	10
Section E, Geol. Soc. of Am. and Assoc. of Am. Geographers	2	9
Section E Exhibits		
Zoological Sciences		
Address of Vice President (Zoologists' Dinner)	1	1
Am. Soc. of Zoologists	8	89
Am. Soe of Zool. (motion pictures)	......	8
Am. Soc. of Zool. (demonstrations)	7	24
Am. Soc. of Zool. (papers by title)	......	138
Am. Soc. of Zool., Bot. Soc. of Am. and Ecological Soc. of Am.	2	8
Am. Soc. of Zool., Am. Soc. of Naturalists, Bot. Soc. of Am. and Genetics Soc. of Am.	1	4
Am. Soc. of Parasitologists	5	58
Am. Soc. of Parasitologists (demonstrations)	1	13
Am. Soc. of Parasitologists (papers by title)	......	30
Botanical Sciences		
Section G, Bot. Soc. of Am., Am. Phytopathological Soc., Am. Soc. of Plant Physiologists, Mycological Soc. of Am., Am. Fern Soc., Sullivant Moss Soc., and Am. Soc. of Plant Taxonomists	1	4
Botanical Soc. of America	9	78

Sections and Societies	Sessions	Papers
Bot. Soc. of Am. and Am. Soc. of Plant Taxonomists	4	25
Bot. Soc. of Am., Genetics Soc. of Am., Ecological Soc. of Am. and Am. Soc. of Zoologists	1	4
Bot. Soc. of Am., Am. Soc. of Zool. and Ecological Soc. of Am.	2	4
Bot. Soc. of Am., Am. Soc. of Plant Physiol., and Am. Soc. for Horticultural Science	1	6
Address of retiring president of Bot. Soc. of Am.	1	1
Bot. Soc. of Am. and Am. Soc. of Plant Physiol.	2	11
Bot. Soc. of Am., Am. Soc. of Naturalists, Am. Soc. of Zool. and Genetics Soc. of Am.	1	4
American Phytopathological Society	9	92
Am. Phytopathological Soc. (demonstrations)	1	20
Am. Phytopathological Soc. and Potato Assoc. of Am.	1	6
Am. Phytopathological Soc. and Mycological Soc. Am.	1	7
Am. Soc. of Plant Physiologists	6	48
Mycological Society of America	3	30
Sullivant Moss Society	2	10
American Fern Society	1	3
Zoological and Botanical Sciences		
Am. Soc. of Naturalists, presidential address	1	1
Am. Soc. of Naturalists, Am. Soc. of Zool., Bot. Soc. of Am., and Genetics Soc. of Am.	1	4
Ecological Society of America	9	56
Ecological Soc. of Am. and Limnological Soc.	1	9
Genetics Society of America	3	28
Genetics Soc. of Am. demonstrations	1	24
Genetics Society of Am. (papers by title)	...	23
Limnological Soc. of America	3	31
Limnological Soc. of Am. (papers by title)	...	12
National Assoc. of Biology Teachers	2	11
Phi Sigma Society	2	15
Beta Beta Beta Honorary Biological Soc.	1	1
Section on Anthropology (H)	1	7
Section H, Section E and Geol. Soc. of Am.	1	10
Section on Psychology (I)	5	30
Section I and Section on Education (Q)	2	8
Section on Social and Economic Sciences (K)	3	11
Section K and Texas Academy of Science	1	3
Section K and Bureau of Business Research, U. of Texas	1	3
Section K and National Resources Planning Board	1	4
National Social Science Honor Society, Pi Gamma Mu	1	1
Section on Engineering (M)	3	7
Section on Medical Sciences (N)	5	33
Subsection on Dentistry	3	15
Subsection on Pharmacy	1	8
Agricultural Sciences		
Section on Agriculture (O) and Am. Soc. for Horticultural Science	1	6
Am. Soc. for Horticultural Science	11	89
Am. Soc. for Horticultural Science (round tables)	2	....
Am. Soc. for Horticultural Science, papers read on demand	.....	107
Am. Soc. for Horticultural Science and Potato Assoc. of Am.	1	7
Am. Soc. for Hort. Sci., Am. Soc. of Plant Physiologists and Bot. Soc. of Am.	1	6
Am. Soc. for Hort. Science and Am. Statistical Assoc.	1	5
Potato Assoc. of Am.	2	17
Potato Assoc. of Am. and Am. Phytopathological Soc.	1	6
Section on Education (Q)	4	26
Section Q and Section on Psychology (I)	2	8

SECTION AND SOCIETY PROGRAMS

SECTION ON MATHEMATICS (A) AND AFFILIATED SOCIETIES

(From reports by Dunham Jackson and Dickson H. Leavens)

Section A (Dunham Jackson, *secretary*) held two joint sessions with the Institute of Mathematical Statistics and the Econometric Society. At the session Monday afternoon A. B. Coble, retiring vice president for the section, delivered an address on "A Certain Set of Ten Points in Space," and S. S. Wilks presented a paper on "Representative Sampling." The program for the Tuesday sessions consisted of 14 contributed papers on a wide variety of subjects, four of which were arranged by the Econometric Society. Presiding officers were G. T. Whyburn, chairman of Section A, H. J. Ettlinger and S. S. Wilks. The attendance included representatives of 18 states and the District of Columbia.

The Econometric Society (Dickson H. Leavens, reporting) held joint sessions with Section A and with the Institute of Mathematical Statistics on Monday afternoon, December 29, and Tuesday morning and afternoon, December 30. Four of the papers presented were arranged by the society. The Dallas meeting gave the econometricians contact with those using the same tools, while a meeting held in New York at the same time in connection with the Allied Social Science Association gave other members of the society contact with those working with the same subject-matter.

SECTION ON PHYSICS (B) AND AFFILIATED SOCIETIES

(From report by Frank C. McDonald)

The American Association of Physics Teachers held a regional meeting of 4 sessions on Monday and Tuesday in connection with Section B. On Monday morning 9 ten-minute contributed papers were presented, with A. L. Hughes presiding. Attendance, 71. At noon 49 of those attending had luncheon together. The first paper Monday afternoon was the address of the retiring vice president for Section B, A. L. Hughes, on "Applications of Electron Scattering."

This paper was followed by two papers on the electron microscope: "Stereo-Microscopy with the Electron Microscope," by V. K. Zworykin and J. Hillier, and "Electron Micrograph Studies of Insect Structures," by A. Glenn Richards, Jr., and Thomas F. Anderson. Attendance, 115. After the scheduled program on Monday afternoon about 50 persons remained for a conference on "Physics and the War," Dean H. L. Dodge leading the discussion.

The two sessions on Tuesday were for the presentation of 8 invited papers on "Applications of Physics to the Oil Industry," which dealt with the seismograph, gravimeter, electrical methods in prospecting, spectroscopy and hydrocarbon reactions. C. A. Heiland gave an interesting paper on "Geophysical Exploration and Its Part in National Defense." The last 2 papers were on "Training Physicists for Work in Geophysics," by Dr. J. C. Karcher and "Training Students for Work in the Petroleum Industry," by Professor E. A. Stephenson. Attendance at the Tuesday morning session, 57; at luncheon, 27; at Tuesday afternoon session, 58.

American Meteorological Society held 4 sessions on December 29–30 at which 14 papers were presented and a round-table discussion for employees of the U. S. Weather Bureau. On Tuesday evening the society held its annual dinner.

SECTION ON CHEMISTRY (C)

(*From report by Neil E. Gordon and William M. Craig*)

Section C presented a three-day program of three symposia on "Biochemistry," "Spectrographic Analysis" and "The Petroleum Industry," the attendance varying from 60 to 200. The papers consisted of reviews of recent developments in the respective fields. Since it is expected that the symposium on "Spectrographic Analysis" will be published by the association, its program will be given somewhat more fully than those of the others.

William M. Craig, who arranged the symposium on "Spectrographic Analysis," introduced it with a discussion of many of the general present-day applications of spectrography to problems of defense as well as those of everyday life, including detection of adulterations of foods, textiles, various metallic alloys and other commonly used products. Ralph A. Sawyer gave a description of the recent spectrographic installations made at the Ford River Rouge plant and at the Bethlehem Steel Company, and explained how analysis of steel can now be made in six minutes instead of hours as formerly. O. S. Duffendack gave an account of recent advances which have been made in research on the electrical sources of arcs or sparks used in making spectrographic determinations. Methods used in the adequate control of the purity of magnesium and its alloys were described by J. L. Saunderson, of the Dow Chemical Company, which has recently installed two large magnesium plants on the Texas coast. Important advances in research on non-metallic substances by spectrographic means were described by Maurice F. Hasler, of the Applied Research Laboratories. Phase rule studies made possible analyses of such materials as glasses, clays and other insoluble or inert and refractory materials. Recent advances in research with the mass spectrometer were described by John A. Hipple, Jr., of the Westinghouse Research Laboratories, who has recently perfected its use in quantitative analysis of gas mixtures. Henry R. Kreider presented a paper on recent advances in using infra-red absorption for the identification of hydrocarbons in petroleum products. Applications in prevention of cancer growth were also discussed. Two papers on spectrum analysis in astronomy, one by C. T. Elvey on "The Spectrum of the Night Sky" and the other by F. E. Roach on "The Chemical Analysis of Stars," were important and appropriate because a large part of modern theories of spectrographic analysis was first worked out in astronomical science. Marshall N. States explained the important characteristics of the photoelectric spectrophotometer and cited its many important uses, including its application in the quantitative determination of vitamin content of foods.

The symposium on "Biochemistry," consisting of 10 papers, covered a wide range of problems in the fields of nutrition, hormones, metabolism and effects of hormones, amino acids and vitamins upon transplantable tumors in rodents and inoperable tumors in man.

The symposium on the Petroleum Industry consisted of 9 papers, covering questions of origin, discovery, production, resources, chemistry and chemicals derived from petroleum. The participants in the symposium were leading chemists, geologists and industrial technologists.

SECTION ON ASTRONOMY (D)

(*From report by C. C. Wylie*)

Section D held 4 principal sessions, including a symposium on problems of teaching, an illustrated lecture on planets by E. C. Slipher and an illustrated lecture on the eclipse expedition to Brazil in 1940 by Paul A. McNally. The invited papers by E. P. Hubble, Paul Sollenberger and others were on the present state of knowledge in the field, rather than on specific research problems. Papers on teaching were contributed by S. L. Boothroyd, Robert L. Price and others. It was maintained that considerable demonstration equipment is necessary for effective teaching and that the cost of a well-equipped students' observatory should be no more than that of a well-equipped physics laboratory. Major G. B. Dany, director of navigation training at Kelly Field, Texas, spoke on the difficult problem of obtaining properly qualified teachers and students in air navigation and asked university men to work with the Army Air Corps toward its solution. Attendance, about 75.

In addition to the programs for the presentation of papers, there was an exhibit of photographs by O. E. Monnig, Frank M. Preucil and C. C. Wylie, text and reference books from several publishers, meteorites and tektites by O. E. Monnig, and demonstration equipment by J. D. Boon. A luncheon arranged by J. D. Boon, host, and O. E. Monnig was held in Virginia Hall of Southern Methodist University.

SECTION ON GEOLOGY AND GEOGRAPHY (E)

(From report by A. C. Swinnerton)

Section E held 6 half-day sessions, December 29–31, at which 41 papers, including the address of the retiring chairman, were presented. One half-day was devoted to general papers, and 4 symposia were arranged for the other sessions. Attendance at two sessions exceeded 100; probably 200 different individuals were present at the 6 sessions.

In the program of general papers notable contributions were made by Charles N. Gould in his intimate account of "Forty Years of Oklahoma Geology" and its influence on the development of the state, and by Hugh D. Miser in his retiring vice presidential address on the "Quartz Veins in the Ouachita Mountains of Arkansas and Oklahoma."

Work on outstanding unfinished and scarcely touched problems of southwestern geology, involving rocks and structures ranging from the Pre-cambrian to the Tertiary, was the theme of 9 papers presented Monday afternoon in a program arranged by a committee of which Charles L. Baker was chairman. On Tuesday morning Oscar E. Meinzer introduced the symposium of 8 papers on the "Relation of Geology to the Ground-Water Problems of the Southwest." A. N. Sayre was chairman of the committee which organized the symposium.

On Tuesday afternoon Section E joined with the Section on Anthropology (H) in a symposium on "Early Man," planned by W. M. Krogman, E. H. Sellards and Thorne Deuel. (Report of Section H.)

Wednesday was devoted to a symposium on "South-Western Geography," planned by Edwin J. Foscue, representative of the Association of American Geographers. Six major papers were presented, covering topics from the history of population to land use. At 3:30 the Section E audience reassembled under the auspices of the Texas Geographic Society to hear an illustrated lecture by J. W. Hoover on "The Havasupai Indians of Arizona."

In all its programs Section E enjoyed the joint sponsorship of the Geological Society of America; for its Monday sessions it was joined by the Texas Academy of Science, the Fort Worth Geological Society and the Dallas Petroleum Geologists; on Tuesday morning by the American Geophysical Union; and on Wednesday by the Association of American Geographers. For the majority of the sessions Morris M. Leighton, chairman of the section, presided; other presiding officers were W. E. Wrather, C. N. Gould, E. J. Foscue and F. B. Kniffen.

One of the scientific exhibits arranged especially for Section E and the association was a remarkable display of geological, geophysical and paleontologic contributions to the development of oil-field production, provided by the Houston Geological Society under the leadership of Paul Weaver. Another noteworthy exhibit was the newly published booklet on the geology of the vicinity of Dallas arranged by C. C. Albritton, Jr.

SECTION ON ZOOLOGICAL SCIENCES (F) AND AFFILIATED SOCIETIES

(From reports by L. V. Domm and O. R. McCoy)

The address of J. T. Patterson, vice president and chairman of the section and a former president of the society, on "Drosophila and Speciation," was read by T. S. Painter on Tuesday evening at the Zoologists' dinner.

The American Society of Zoologists (L. V. Domm, *secretary*) held its 39th annual meeting on Dec. 29–31, 1941, in conjunction with Section F and in association with several other biological societies. The meeting was noteworthy for the outstanding character of three symposia and the great variety of papers presented at the regular sessions.

The first symposium, under the leadership of B. H. Willier, was held on the opening morning. The three participants in it presented a critical review of "The Genetic Control of Embryonic Development." The small number of speakers permitted considerable discussion, a feature greatly appreciated by those in attendance. Attendance, about 250.

The second symposium, organized by J. T. Patterson, was held jointly with the Botanical, Ecological and Genetics Societies and dealt with the problem of "Isolating Mechanisms." The four participants presented a critical and well-coordinated account of this important and widely investigated problem. Estimated attendance, about 450 persons.

The third symposium, organized by H. H. Plough, a former vice president of the society, was on "Temperature and Evolution." It was held jointly with the Botanical and Ecological societies in two sessions on the second and third mornings of the meeting. There were four participants in each session who presented a well-coordinated and very valuable account of this general and greatly diversified subject. Approximately 300 persons were in attendance at each session.

Although the number of papers read in person at the 7 regular sessions was not as large as that of the last annual meeting, nor were there as many demonstrations, yet it was the consensus of opinion among those in attendance at both meetings that the Dallas meeting was exceptional in the variety of papers presented, as well as in the intense interest shown. In all, 101 papers were presented, and in addition, there were 24 demonstrations, a special feature of which was the cinema program, the attendance of which was estimated to have been about 300 persons. Estimated attendance at regular sessions, 500 different persons.

Officers for 1942 are: *President,* L. L. Woodruff; *vice president,* C. G. Hartman; *treasurer,* H. W. Beams; *member of Executive Committee,* R. E. Coker.

The American Society of Parasitologists (O. R. McCoy, *secretary*) held its annual meeting on December 29–31, with James E. Ackert presiding as president. The program contained 88 titles representing the fields of protozoology, helminthology and medical entomology.

The opening session on Monday was devoted to papers on the morphology and life histories of trematodes; in the afternoon veterinary parasitology was the chief topic of discussion. Papers on the immunology of parasitic infections featured the Tuesday morning session at the conclusion of which the presidential address on "Natural Resistance to Helminthic Infections" was delivered by James E. Ackert.

The annual parasitologists' luncheon, attended by 95 members and guests, was held Tuesday noon. In the afternoon 13 papers were presented at a demonstration program, during which tea was served. The concluding session on Wednesday was devoted mostly to papers on protozoology and included a promising report by Wendell D. Gingrich on the use of a new drug, acranil, in the treatment of malaria in birds.

The following officers of the society were elected: *President,* Henry E. Meleney; *vice president,* Rudolph W. Glaser; *secretary,* for two years, Oliver R. McCoy; *members of council,* for four years, Raymond M. Cable and Willard H. Wright, and for three years, Gilbert F. Otto; *members of the editorial board,* for four years, William W. Cort, Harold Kirby, Jr., and Benjamin Schwartz. Professor Juan Bacigalupo, Buenos Aires, Argentina, was elected an honorary foreign member.

SECTION ON BOTANICAL SCIENCES (G) AND AFFILIATED SOCIETIES

(From reports by G. W. Martin, Paul R. Burkholder, E. M. Betts, D. B. Anderson, W. H. Camp, H. N. Andrews, Jr., J. A. Pinckard, Paul J. Kramer, J. N. Couch, Winona H. Welch and Joseph Ewan)

Section G met in joint session with the Botanical Society of America, American Phytopathological Society, American Society of Plant Physiologists, Mycological Society of America, American Fern Society, Sullivant Moss Society and the American Society of Plant Taxonomists, with an attendance of about 300, G. M. Smith, vice president for the section, acting as chairman. M. L. Fernald, retiring vice president, was unable to attend the meeting and his address, "Some Historical Aspects of Plant Taxonomy," was read by S. W. Geiser. This was followed by three invitation papers: R. W. Chaney on "Plant Distribution During the Past Fifty Million Years," W. H. Camp on "The Individual in Relation to Complex Populations in Vaccinium" and L. J. Stadler on "Some Experiments on Gene Mutation."

The Botanical Society of America (Paul R. Burkholder, *secretary;* Edwin M. Betts, Donald B. Anderson, W. H. Camp and Henry N. Andrews, Jr., *secretaries* of sections of the society) held sessions for presentation of papers under the auspices of its General, Physiological, Systematic and Paleobotanical Sections. The society joined with Section G and other societies affiliated with Section G in a varied program of invitation papers dealing with topics in the fields of taxonomy, paleobotany and genetics. Joint meetings were held with other groups for discussions on "Isolating Mechanisms," "Temperature and Evolution" and "Human Genetics." A symposium on "Teaching of Plant Physiology," with Dorothy Day presiding, and a "Forum on Teaching Plant Science," with W. F. Loehwing as leader, were held in cooperation with the American Society of Plant Physiologists. Both of these meetings were very stimulating and well attended.

The General Section held three sessions for the presentation of 35 papers. The papers at the opening session were devoted mainly to cytology and various phases of genetics. Papers read at the second session dealt almost entirely with physiology and ecology, including discussions of such subjects as "Traumatic Acid and Mitosis in *Ricinus communis,*" "Physiological Studies on Mosses," "Frost Injury

Artificially Induced in Arizona Cypress" and "Development of Adventitious Roots in Stem Cuttings of *Tropaeolum majus.*" At the final session the papers dealt with various aspects of plant anatomy, including "Notes on Growth and Differentiation in the Marsileaceae," "The Embryogeny of Pseudolarix and Keteleeria," "Cell Growth and Division in a Living Root Meristem" and "Embryo and Endosperm Formation in *Illicium floridanum.*" Officers of the section for 1942: *Chairman,* E. B. Matzke, *secretary,* E. M. Betts.

The Physiological Section held two sessions for the presentation of 21 papers. The subject of growth in relation to auxins and environmental factors was prominent on the program, but a wide range of other topics, including water and mineral element absorption, respiration, photosynthesis, seed dormancy and germination, stomatal behavior and micro-analysis, also received attention.

The joint symposium on "Experimental Design and the Control and Measurement of Error in Physiological Investigations" was held with the American Society of Plant Physiologists and the American Society for Horticultural Science. A panel of members led the discussion on a question-and-answer basis with the audience also participating. This unusual program proved to be very successful and informative and was well received by an audience of about 100 members.

Officers for the section for 1942: *Chairman,* H. W. Popp; *secretary,* D. B. Anderson.

Of the four sessions of the Systematic Section, two were devoted to "The Origin and Development of the Floras of the Southwest: (1) The Analysis of a Desert Region; (2) The Edwards Plateau (Texas)—Ozark Mountains Transect." Papers were presented before the third session on such varied topics as Louisiana prairies, noteworthy plants from Minnesota and New Mexico, freshwater and marine algae, impurities in seed samples, species problems in *Quercus* and *Polygonatum,* and a general consideration of the mechanisms involved in the production of species. The final session was concerned mainly with phylogeny and distribution, including studies on wood anatomy in the Gruinales and Terebinthales and interspecific relationships of the North American species of *Cornus, Delphinium* and *Ranunculus.* It was evident throughout the sessions that American plant systematists are making increased use of experimental methods in their work, as well as bringing their interpretations into closer accord with sound phytogeographical principles based on paleontological evidences and the recent advances in geohistory.

Officers for the section for 1942: *Chairman,* C. A. Weatherby; *secretary,* W. H. Camp.

The Paleobotanical Section met for three half-day sessions devoted to the presentation of technical papers and one half-day session for the demonstration of specimens. At the first session a number of papers were presented on the Pennsylvanian flora of the central states and on Pleistocene pollens and Devonian algae. At the second session N. W. Radforth reviewed the fossil history of the Schizaeaceae, and M. K. Elias discussed tertiary herbs and related paleobiologic problems. The third session was devoted entirely to investigations on the microfossils of Tertiary and Pennsylvanian coals. These three sessions were attended by approximately 40 persons.

Officers of the Botanical Society of America for 1942: *President,* M. L. Fernald, *vice president,* G. M. Smith; *secretary,* P. R. Burkholder; *treasurer,* Paul Weatherwax.

The American Phytopathological Society (J. A. Pinckard, reporting) held its 33rd annual meeting from Dec. 29, 1941–Jan. 1, 1942. Arranging its program in sections, it held 12 sessions in addition to several special conferences, demonstrations, round table discussions and dinners. In the 11 regular sessions 125 papers were scheduled, although only 107 papers were presented, 80 in regular sessions, 20 in special demonstrations, and 7 in the seed treatment conference. Continuing the society's long-standing policy of close cooperation with other branches of science, joint sessions with 6 other organizations were held. In addition, a series of informal conferences among the members of the society brought to light several proposals of immediate importance. By far the most important of these was a panel discussion on "Plant Pathology in Relation to National Defense and Post-War Readjustments," sponsored by the society's Extension Work and Relations Committee.

Several speakers at the conference pointed out how the impact of war upon the United States has demanded the redirection of research in certain branches of science. The urgent need for more and better foods, fibers and plant products for human and animal use was stressed, with significant illustrations drawn from the previous war. Experiences with outbreaks of ruinous epidemics among vital agricultural crops, which occurred in both Germany and the United States during the last war, prompted the members of the society to urge the council to immediate action, and for the second time in the history of the society a War Emergency Committee was appointed, consisting of J. G. Leach, Richard P. White and E. C. Stakman, to weld the regional plant disease work of the United States into a war-service action program and to represent the society in whatever capacity seemed appropriate for the furtherance of national defense and post-war readjustments.

Although the society was gravely concerned over the possible development of epidemics of plant diseases in a world at war, many excellent and timely reports of progress were heard. Results of a nationwide cooperative experiment carried out under the direction of the committee for coordination of research in cereal and vegetable seed treatments and the cotton seedling disease committee clearly showed how appropriate seed treatments can prevent substantial losses among certain crops.

The session on fruit diseases and fungicides included papers on a new disease, a new method for the control of raspberry anthracnose, and considerable information on the behavior of fungicides and their performance. At the session on tobacco and virus diseases, new information was presented on the role of potash in tobacco leafspot diseases and on the presence of a leafspot bacterium in the soil.

Demonstrations of the work of plant pathology in Texas and in Kansas were on exhibition in the Baker Hotel, while 20 exhibits of work by individual plant pathologists were located near the conference rooms of the society. Although the demonstration method of reporting progress is a relatively new undertaking of the society, the large attendance and interest shown indicated that demonstrations may become a permanent part of the program.

The Dallas meeting was attended by approximately 225 plant pathologists, 170 of whom enjoyed the annual Phytopathologists' dinner after which the new officers of the society for 1942 were announced: *President,* Lee M. Hutchins; *vice-president,* J. C. Walker; *councilor,* H. A. Rodenhiser. The council appointed C. C. Allison *secretary* to succeed R. S. Kirby. Membership in the society now stands at 1,112. New members elected, 75.

The meeting of the American Society of Plant Physiologists (Paul J. Kramer, *secretary*) was featured by an unusually large number of symposia and joint sessions. The Monday afternoon symposium on "Electrodynamics of Living Systems," presided over by E. J. Lund, brought together plant and animal physiologists for consideration of the significance of electrical potentials in plant and animal tissues. L. R. Blinks discussed electrical phenomena in large plant cells, Gordon Marsh the effects of radiation on bioelectric processes, and George H. Bishop the electrical potentials of nerve structures.

The Tuesday afternoon symposium with the American Society for Horticultural Science and the Physiological Section of the Botanical Society dealt with the proper planning of experiments. It represented an interesting departure from the usual program because, instead of a few formal papers, a round-table discussion was held in which a panel of experts and members of the audience participated. An attempt was made to show in non-technical language the advantages of correctly designing experiments so that the results can be properly evaluated and the effects of certain undesirable factors can be eliminated. The program was arranged by V. R. Boswell, who led the discussion, and presided over by B. S. Meyer of the Physiological Section.

Teaching problems also received considerable attention, two joint symposia being held with the Botanical Society. The Tuesday evening symposium presided over by Dorothy Day dealt primarily with the teaching of plant physiology. Walter F. Loehwing presided over the Wednesday afternoon symposium which dealt with plant science teaching in general and especially the objectives of college botany courses.

The Monday morning program consisted of papers on bioelectric currents, responses to light and mineral nutrition of plants. The Tuesday morning general session included papers dealing with physiological techniques and plant chemistry. The Wednesday morning session included papers on dormancy in seeds and buds, a group of papers on photosynthesis and a group of 4 papers dealing with the absorption of water and the root pressure mechanism. Hilda F. Rosene described an apparatus to measure the absorption of water by single root hairs and Rosene, Eaton and van Overbeek discussed the root pressure mechanism. Apparently at least two and perhaps more mechanisms are involved, possibly including an osmotic mechanism and another inhibited by cyanide. The Wednesday afternoon session consisted of a group of papers dealing with various phases of the plant hormone problem.

At the annual plant physiology dinner on Monday evening, presided over by E. C. Miller, president of the society, the award of a Charles Reid Barnes Life Membership was made to Dr. Benjamin M. Duggar in recognition of his outstanding contributions to plant physiology. Dr. Philip R. White, of the Rockefeller Institute, Princeton, New Jersey, gave the Stephen Hales Prize address, "Vegetable Dynamicks and Plant Tissue Cultures," in which he discussed the techniques, problems and contributions of that important field of research. Attendance, nearly 100.

The Mycological Society of America (J. N. Couch, *secretary*) held three sessions at its 9th annual meeting. E. A. Bessey, in his presidential address, discussed the phylogeny of the fungi. One session was held on soil fungi. Several papers dealt with the relationship between environment and soil-borne fungal diseases. The possible control of harmful soil fungi by induced maximal bacterial populations was sketched as the most recent development. Another session was devoted to fungous diseases of man and animals. Coccidiomycosis was found in rodents in Arizona and *Coccidioides immitis*, the causal organism, was found there in the soil. A new and more precise method of classifying the yeast parasites was presented. The spores of certain fungi, as Caspergillus, Penicillium, Rusts, Smuts, Mucors, etc., were found to be associated with certain types of "hay fever and asthma."

Additional work on the genetics of corn smut and Glomerella was described in a third session. Other significant papers threw new light on the nuclear behavior on the Mucorales and the relation between the nutritional requirements of Allomyces and its distribution. Greenhouse control of the mealy bug by a parasitic fungus was described in the joint session with the Phytopathological Society.

Officers for 1942: *President,* E. B. Mains; *vice president,* J. N. Couch; *secretary-treasurer,* G. B. Cummins.

The program of the Sullivant Moss Society (Winona H. Welch, *secretary*) concerned noteworthy mosses, liverworts and lichens in numerous states; the distribution of the Genus Drepanocladus; a homology in *Riella americana* as applied to the gemma and spore; gametophyte regeneration in *Physcomitrium turbinatum;* distribution of hepaticae in space and time; and a biography of Mary Parry Haines.

Officers for 1942: *President,* H. S. Conard; *vice president,* T. C. Frye; *secretary-treasurer,* Winona H. Welch.

The American Fern Society (Joseph Ewan, *reporting*) held its annual meeting on Jan. 1, 1942. The formal program consisted of a paper presented by the society's vice president, Joseph Ewan, on "Problems Suggested by Field Work with the Aquatic Pteridophyta of Colorado." It outlined the three types of problems, taxonomic, ecologic and phytogeographic, centering about the three genera Marsilea, Equisetum and Isoetes.

Apart from the formal meeting, two exhibits of ferns were placed on the tables for examination, one by Mr. and Mrs. G. M. Soxman of Texas species collected over the entire state; and the other of Colorado-Wyoming ferns provided by Joseph Ewan.

SOCIETIES RELATED TO BOTH THE SECTION ON ZOOLOGICAL SCIENCES (F) AND THE SECTION ON BOTANICAL SCIENCES (G)

(From reports by W. J. Hamilton, Jr., B. P. Kaufmann, J. E. Ackert and Paul S. Welch)

The American Society of Naturalists, in cooperation with the American Society of Zoologists, the Botanical Society of America and the Genetics Society of America, sponsored a symposium on "Human Genetics," consisting of four papers by Laurence H. Snyder, Herluf H. Strandskov, Charles W. Cotterman and Lionel S. Penrose. This symposium will be published in the *American Naturalist.* At the Naturalists' dinner in the evening W. W. Cort, president of the society, delivered his presidential address on "Human Factors in Parasite Ecology."

The Ecological Society of America (W. J. Hamilton, Jr., *secretary*) held its meeting on December 29–31. Seventy-one papers were presented by members. On Monday afternoon a joint symposium on "Isolating Mechanisms" was held in combination with the Genetics Society of America, the American Society of Zoologists and the Botanical Society of America. The well-attended Ecologists' dinner was held Monday evening, at which the retiring president, Alfred E. Emerson, delivered an address on "Ecology, Evolution and Society."

On Tuesday morning, a joint symposium on "Temperature and Evolution" was held in conjunction with the American Society of Zoologists, at which papers were presented by H. H. Plough, G. Fankhouser, George P. Child and Emil Witschi. A joint session was held the same afternoon with the Limnological Society of America, at which A. S. Pearse presided. A field trip on Thursday morning was led by Willis G. Hewatt.

Officers for 1942: *President,* C. F. Korstian; *vice president,* Claude ZoBell; *secretary,* W. A. Dreyer.

The Genetics Society of America (B. P. Kaufmann, *secretary*) arranged a three-day program consisting of 6 sessions for the presentation of scientific papers and the annual business meeting and luncheon. Two mornings were devoted to the reading of 22 short papers, and a third to a program of 6 papers selected for more extended presentation. A demonstration program of 24 papers occupied one afternoon, and on the other afternoons members of the society participated with other societies in symposia on "Isolating Mechanisms" and "Human Genetics."

The invitation program featured an important study of G. W. Beadle and E. L. Tatum on Neurospora, showing that the production of certain substances such as pyroxidine and para-aminobenzoic acid may each be dependent on single gene differences. T. M. Sonneborn reported a high mutability rate of a gene determining mating types in *Paramecium aurelia* under the influence of temperature at the time that the macronuclei develop from the micronuclei. A. W. Pollister and A. E. Mirsky, in an analysis of biochemical differences attending cellular differentiation, described the preparation of a nucleohistone from mammalian organs and demonstrated its nuclear origin. H. E. Warmke outlined a new method by which induced polyploidy may be used to determine the sex heterozygote in species of plants with morphologically undifferentiated sex chromosomes. H. Roman reported on translocations involving the "B" chromosomes of maize and their bearing on cytogenetic problems. J. W. Gowen presented evidence that differences in numbers of red and white cells are correlated with differences in resistance and susceptibility to typhoid among six strains of inbred mice. The annual luncheon was attended by 138 and the society voted to meet with the A.A.A.S. in New York next December.

Officers for 1942: *President,* E. W. Lindstrom; *vice president,* M. M. Rhoades; *secretary,* B. P. Kaufmann.

The American Microscopical Society (J. E. Ackert, *secretary*) met on December 29. At the executive committee luncheon, which was attended by three past presidents and most of the officers, reports were presented which showed the society to be in a thriving condition. During the year 540 pages of original material in biology and microscopy were published in the Quarterly Transactions with the aid of several grants from the Spencer-Tolles Fund, a society endowment amounting to over $22,000.

The society voted to meet in 1942 in New York with the A.A.A.S. and named J. E. Ackert and A. M. Chickering as representatives on the council of the association.

Officers for 1942: *President,* John W. Scott; *first vice president,* G. W. Prescott; *second vice president,* R. P. Hall; *elective member to the executive committee* (three years), L. J. Thomas.

The Limnological Society of America (Paul S. Welch, *secretary-treasurer*) held its seventh annual meeting on December 29–31. The scientific program occupied 4 half-day sessions, one of which was a joint session with the Ecological Society of America. Papers in the first two half-day programs were concerned largely with general limnological matters, including pollution studies, lake sediments, chemical composition, plankton studies, reservoir lakes, lake types, acclimatization and certain limnological techniques. The third half-day program was devoted to papers concerned primarily with the limnological aspects of fisheries biology. In the joint meeting with the Ecological Society, the limnological contributions involved papers dealing with limnological excursions in Trans-Pecos Texas and Mexico, chemical and physical conditions in Philippine lakes, microfossils in lake sediments, limnological variables in a Colorado mountain stream and horizontal distribution of copepods inhabiting intertidal beaches. On Wednesday the society conducted a field trip to Eagle Mountain Lake and certain other points of limnological interest.

Officers for 1942: *President,* George L. Clarke; *vice president,* A. H. Wiebe; *secretary-treasurer,* Paul S. Welch; and *elective member of the executive committee,* G. E. Hutchinson.

The National Association of Biology Teachers held two sessions on Monday for the presentation of papers, and a dinner on Monday evening. Eleven papers were presented, of which three were illustrated lectures: "Texas Amphibians," by Ottys Sanders; "Reforestation and High School Biology," by Lida Rogers; and "Yellow Fever, Plague and Typhus—Smoldering Threats," by Asa C. Chandler. At the dinner the address by Walter F. Loehwing was on "Biology, Appraisal and Forecast."

Phi Sigma Society (A. I. Ortenburger, *secretary*) held two business meetings, one scientific meeting and one dinner. Twenty-eight chapters were represented by official delegates, and the total attendance was over 50. Fourteen papers were presented by members at the scientific meeting.

At the dinner, Dr. M. Ruiz Castaneda of the Hospital General, Departamento de Investigaciones Medicas, Mexico, D. F., gave an illustrated lecture on typhus fever. He discussed the discovery of a successful vaccine for typhus, effective not only for the endemic, but also for the epidemic, or European, type. This serum, which is made from the lungs of inoculated rodents, can be prepared by ordinary laboratory technicians on a large enough scale to protect entire armies. The great importance of Dr. Castaneda's work becomes apparent when the high typhus toll in the last war is recalled.

Officers elected are: *Chancellor,* Paul A. Warren; *treasurer,* E. H. Stewart.

SECTION ON ANTHROPOLOGY (H)

(From reports by T. N. Campbell and A. C. Swinnerton)

Section H (W. M. Krogman, *secretary;* T. N. Campbell, *secretary pro tem.*) held one brief session on Monday afternoon, and on Tuesday afternoon met with the Section on Geology and Geography (A. C. Swinnerton, *secretary*) for a joint symposium on "Early Man."

At the Monday afternoon session 7 papers were read, 4 of them by title. G. W. McGinty described the Negro exodus from Louisiana during the years 1879–1881, and Early W. Count presented a paper on race identity as a growth phenomenon. At the close of the session, W. Duncan Strong delivered his retiring vice presidential address on "Recent Archaeological Research on Latin America."

The joint symposium on "Early Man" was attended by approximately 100 persons. Seven papers were read, all demonstrating the urgent necessity of cooperation between archaeologists and geologists in attacking the problem of early man. In a paper on "Fossil Man and the Origin of Races," W. W. Howells presented the view that the primitive features of modern man indicate a separate line of cranial development and that *Homo sapiens* is as old as the other forms of man. The remainder of the papers dealt with various phases of the problem of early man in America. Robert M. Adams reported evidences of early human occupation in eastern Missouri; A. O. Bowden and Ivan A. Lopatin described a human skeleton from late Pleistocene deposits in southern California; and Frank C. Hibben summarized the results of recent archaeological reconnaissance in Alaska. Two significant Alaskan discoveries were reported by Hibben: Yuma points from the muck deposits in the vicinity of Fairbanks, and a stratified site on Cook Inlet which yielded points of a Folsom-like type. Edgar B. Howard gave a critical appraisal of the Folsom and Yuma problem and presented the results of recent excavation at a Yuma site near Eden, Wyoming. In two papers attention was given to the question of alluvial terrace deposits as chronological criteria. Glen L. Evans reported artifacts in the second terrace of the Rio Grande River in Southern Texas, and E. H. Sellards cited additional evidence from Texas River terraces to show how such terraces may be of use in determining the age of included archaeological remains. The latter paper evoked favorable discussion among the geologists present.

SECTION ON PSYCHOLOGY (I)

(*From report by John A. McGeoch*)

The sessions of the section were attended by psychologists from both coasts, as well as by those from the Middle West and South. The program consisted of 4 sessions of contributed papers, two symposia, one of them with the Section on Education, and a joint dinner with the Section on Education at which the retiring chairmen of the two sections delivered addresses.

The contributed papers covered a wide range of problems in the special fields of human and animal learning, perception, abnormal psychology and personality, mental testing and applied psychology and the psychological problems of national defense.

In the symposium on "Recent Advances in the Appraisal of Personality," organized by E. R. Hilgard, papers were presented by Pearl Bretnall, D. G. Humm, F. A. Pattie and Dael Wolfle. Results from four different methods of appraising personality were reviewed—play and other expressive productions, paper and pencil tests, hypnosis and factorial analysis.

The joint symposium with the Section on Education, organized by A. W. Melton and H. H. Remmers, was devoted to the "Psychology of Learning and the Educative Process." The papers by three psychologists, E. R. Hilgard, N. L. Munn and John A. McGeoch, were characterized by complete agreement on the principles and data of psychology which are significant for education and on the practical interrelatedness of the two fields. The unanimity displayed constituted an important demonstration of the systematic integration which has been developing in psychology. The papers from Education were by Harold F. Clark and Hyman Meltzer. The former described an extensive and socially important experiment on the influence of diet on learning. The latter uniquely surveyed the relations between mental hygiene and the learning process. These papers significantly illustrated the interrelation of education and psychology which was documented by the entire symposium.

On Tuesday evening Karl M. Dallenbach, vice president and chairman of the Section on Psychology, read a scholarly address on "The Temperature Senses: Their History and Present Status," in which he reviewed the development of research on these senses and summarized the results of recent research, with particular reference to the receptors involved. E. J. Ashbaugh, vice president and chairman of the Section on Education, presented the problems of learning to read, with illuminating reference to their relation to the construction of the language, in an address entitled "Education as Science and Art."

SECTION ON SOCIAL AND ECONOMIC SCIENCES (K) AND AFFILIATED SOCIETIES

Section K (Bruce L. Melvin, *secretary pro tem.*) held 6 sessions from Monday to Wednesday, inclusive, at which 23 papers were presented. The subject of the first session, held in cooperation with the Texas Academy of Science, under the chairmanship of J. Wheeler Barger, was "The Basic Economic Pattern." Papers were presented by C. A. Bonnen, T. G. Standing and Elmer H. Johnson. The subject of the second session, held in cooperation with the Bureau of Business Research of the University of Texas, under the chairmanship of A. B. Cox, was "The Industrial Pattern." Papers were presented at this session by Frank Rader, Elmer H. Johnson and George H. Anderson. The subject of the third session, Daniel Russell presiding, was "Population Patterns." E. D. Tetreau, Joe E. Motheral, Homer L. Hitt and Kalvero Oberg were the contributors. George I. Sanchez presided at the fourth session, the subject of which was "Problems of Adjustment Among Spanish Americans." The speakers on this program were George I. Sanchez, M. C. Gonzales, H. T. Manuel and A. L. Campa. "Problems of Adjustment among the Indians of the Southwest" was the subject of the fifth session, at which Allen G. Harper presided. The papers were by W. V. Woehlke, E. R. Fryer and D'Arcy McNickle. Allen G. Harper presided at the sixth session at which 4 papers were presented on "Planning to Meet Emerging Problems," one each on urban areas, agriculture, industry and the region.

The National Honor Social Science Society, Pi Gamma Mu (Leroy Allen, *secretary*), held its luncheon Wednesday noon under the chairmanship of S. Howard Patterson, *president*. J. L. Clark was toastmaster. The feature of the luncheon was an address by Bruce L. Melvin on "Opportunities for Social Scientists."

SECTION ON ENGINEERING (M)

(*From report by W. R. Woolrich*)

The section held two sessions on December 31 at which 6 papers were presented and a luncheon at which Everette DeGolyer delivered an address on "The Oil Reserves of Iraq and Iran." At the first session, at which W. R. Woolrich presided, the papers presented were on "The Philosophy of Engineering Education," by R. L. Sackett (read by the chairman), "The Role of Strategic Material in Our National Defense," by John R. Suman, and "Aeronautical Engineering—its Today and Tomorrow," by M. J. Thompson. At the afternoon session, D. C. Proctor presented a paper on "Industry in the Present Emergency," Ross White, one on "Modern Construction of Large Dams," and James M. Ketch, one on "Research in Electrical Engineering."

SECTION ON MEDICAL SCIENCES (N)

(*From reports by Malcolm H. Soule*)

Section N held 4 sessions with programs on the mornings and afternoons of Tuesday and Wednesday, at which 33 papers were presented. Of these papers, 20 were by special invitation and formed a symposium on "Relapsing Fever." The remaining 13 titles were unusually interesting contributions on various branches of medical science, including cardiology, endocrinology, biochemistry and bacteriology.

The symposium, the first on relapsing fever in the history of medicine, treated this malady as it exists in the United States and Central America. The first paper was a biography of Otto Obermeier, concerning whose life little is known, by Konrad Birkhaug of Bergen, Norway. Obermeier discovered a tiny microorganism in the blood of patients with relapsing fever during the Berlin epidemic of 1867. However, the epidemic passed before he was able to establish firmly his conclusions and he was forced to wait 5 years for another epidemic to make available the necessary clinical material. Even though the evidence was ample, scientists were not prepared to accept a germ as an agent of disease. Obermeier died of cholera at the age of 30. It was his misfortune that his discovery became temporarily obscured by the triumphant bacteriological work of Robert Koch, a colleague, and Pasteur. Nevertheless, the finding of *Spirochaeta Obermeieri* emerges from that glorious epoch as a distinctive contribution to medical progress.

The tribute to Obermeier was followed by a series of papers which covered the distribution of relapsing fever in Texas, Oklahoma, California and Panama. Unquestionably one of the most important conclusions gained from these studies was the firm conviction that this disease has no geographical limitations. It may be present wherever there are infected ticks. Several papers followed on tick vectors and the life of the microorganism in infected ticks. Under laboratory conditions infected ticks have been maintained viable in a fasting state for 11 years and there is no reason to believe this interval marks the limits of their longevity. Thus an explanation is available for outbreaks of relapsing fever in association with caves and houses over long periods of time. The final group of papers of the symposium was devoted to the poorly understood phases of the life cycle of the spirochetes, its effect on the human host, the diagnosis of the disease and its importance as a public health problem. The European disease studied by Obermeier is louse-borne and in times of strife, such as the present, may cause great suffering and death wherever humans are concentrated under somewhat primitive conditions. In the western hemisphere the disease is tick-borne and, while markedly debilitating, it rarely causes death in the well-nourished human host. Those charged with the care of the health of our armed forces will certainly be pleased that it is expected that the symposium papers will be published by the association and give the latest and best information about this malady.

On Tuesday afternoon E. W. Goodpasture delivered his vice-presidential address before a general session on "Intracellular Parasitism in Human Infectious Diseases." Particular attention was focussed on intercellular parasitism in Rickettsial, Bartonella, bacterial, yeast, protozoan and virus diseases of man in which intracellular parasitism is either obligative or facultative. Certain implications of the cell-parasite relationship were discussed with reference to pathogenesis, immunity and chemotherapy. Attendance at each session, about 55.

SUBSECTION ON DENTISTRY (Nd)

(*From report by Paul C. Kitchin*)

With the exception of a few miscellaneous papers, the entire three-session program of the subsection consisted of papers on "Public Health Aspects of Dentistry with Special Reference to Fluorine." Almost every research worker who has had a leading part in the investigation of fluorine relations to dental conditions took an active part in this symposium.

Fluorine has been definitely proved to be responsible for the dental condition variously known as "Brown Spots," "Colorado Brown Stain," "Mottled Enamel" and "Dental Fluorosis." This tooth enamel malformation, subsequently stained through other agencies, is due to the ingestion, during the first 8 years of life, of water containing fluorides. Amounts of fluorides in excess of two parts per million of water are capable of causing visible effects on the forming teeth.

Mottled enamel was first recognized and made a subject of study by F. S. McKay beginning in 1903. In 1916, in conjunction with G. V. Black, he published his first paper on the subject, establishing its limited geographical distribution. Until 1930 no cause for the mottled enamel had been found. Then H. V. Churchill, chief chemist of the Aluminum Company of America, using the better methods of water analysis that had been developed, established beyond question the presence of fluorine in water supplies of numerous areas of endemic mottled enamel and its absence where no mottled enamel occurred. Animal experimentation confirmed the conclusion that mottled enamel is produced by fluorides in the water used.

Thus far, as was pointed out, fluorine had been known to play only a destructive role. Within recent years evidence has been accumulating to indicate that its presence in water in small and optimal amounts seems to reduce materially the occurrence of dental decay. Although the mode of action is not yet known, the enamel of teeth resistant to dental decay has been shown to contain significantly greater amounts of fluorine than is present in those which are susceptible to dental decay. It is expected that this authoritative survey of an important public health problem will be published as a monograph by the association.

SUBSECTION ON PHARMACY (Np)

(*From report by Glenn L. Jenkins*)

Subsection Np held two sessions on December 29 at which 9 papers were presented, including a report by Donald Slaughter on "Prostigmine Potentiates and the Hypnotic and Analgesic Action of the Barbiturates"; the results of a study by Loyd E. Harris on Petro wax and a report by him that Ephedra Nenadensis Wats. growing in southwestern Oklahoma contains no ephedrine; the results obtained by C. H. Walden and G. L. Jenkins in their study on Hermidium Alipes, S. Wats., which proved that this drug contains a substance that increases blood pressure in a manner qualitatively and quantitatively similar to that of epinephrine; and a paper by T. C. Barnes on the electrical potential of frog skin in which he showed that the oxygen consumption is decreased about 40 per cent. by 1 per cent. sulfanilamide and that the excised auricles of the turtle are stimulated.

SECTION ON AGRICULTURE (O) AND AFFILIATED SOCIETIES

(*From reports by M. F. Morgan, H. B. Tukey and F. M. Blodgett*)

Section O (M. F. Morgan, *secretary*) held a joint session with the American Society for Horticultural Science, at which W. H. Chandler, retiring vice president and chairman for the section, presented a critical review of the changing pattern of agricultural science during the present century. The various roles of the experiment stations in developing scientific principles fundamental to the art of agriculture, of the agricultural colleges in training for service, of the extension organizations in the spread of helpful knowledge and of the governmental action agencies in promoting desirable farm practices were sharply portrayed. The need for more thorough training of agricultural students in the basic sciences, for a clearer understanding of the distinction between the art of farming, as best gained on the farm, and the scientific facts that can be imparted through agricultural training in secondary schools and for closer integration of the federal action agencies with the adult education program of the extension services were frankly discussed. The session also included a group of papers giving special attention to the development of floral primordia and the conditions essential to gametic union in relation to horticultural crops. Blossom induction was shown to be initiated at much earlier periods than was formerly believed. The environmental conditions at this stage exert profound influences upon such disorders as biennial bearing in apples and bud abscission in solonaceous plants. Attendance, about 175.

The American Society for Horticultural Science (H. B. Tukey, *secretary*) held its 38th annual meeting in 13 sections on the campus of Southern Methodist University. The number of papers and the number and nature of the sectional sessions showed the general tenor of scientific research and thought in horticulture throughout the country. There were sections on breeding and varieties of fruits, on nut crops, on nutrition and quality of vegetables, on growth and production of fruits, on breeding of vegetables, on problems in floriculture and ornamental horticulture, on propagation and developmental morphology of fruits and on culture and developmental morphology of vegetables. The rapid development of scientific horticulture in the South and the Southwest was shown by the large number of papers dealing with citrus fruits, tung, pecans, winter vegetables and the breeding of vegetable crops, fruit and nut crops and ornamental and floricultural crops. Round-table discussions were held on educational methods, on nomenclature and varieties and on experimental design.

Again the interest of the society in related fields of scientific effort is shown by joint sessions with the Potato Association of America on "Potato Problems"; with the American Society of Plant Physiologists and Physiology Section of the Botanical Society of America on "Experimental Design and Control and Measurement of Variation in Physiological Research"; and with the Biometric Section of the American Statistical Association on "Efficiency in Recent Methods for Controlling Field Heterogeneity."

The Potato Association of America (F. M. Blodgett, reporting) held its 28th annual meeting Dec. 29–31, 1941. The meeting was featured by three symposia, one on the value of southern seed testing trials, a second on new developments in certifying seed potatoes and a third on the bacterial ring rot disease. It was the belief of those present that the bacterial ring rot problem is being satisfactorily solved in most areas through the use of clean seed coupled with suitable sanitary precautions.

F. J. Stevenson, of the U. S. Department of Agriculture, was elected president for 1942.

SECTION ON EDUCATION (Q)

(From report by H. H. Remmers)

Section Q held 4 sessions at which 21 papers were presented, a panel discussion by 5 participants, a joint session with the Section on Psychology at which 6 papers were presented and a joint dinner with the Section on Psychology, at which the retiring vice presidents for the sections delivered their addresses.

The general theme for the section was conservation of resources, material and human. Most of the papers naturally considered regional problems of the South —the decline of illiteracy, soil depletion and the popularization of teaching conservation in the public schools. The final session dealt particularly with human resources in rural areas. A half-day session devoted to relatively technical papers deviated somewhat from the direct emphasis on conservation. In this session reports on responses of Negro children to the revised Stanford Binet Intelligence Test, the relation of peripheral perception in reading, potential contribution to English vocabulary of high-school Latin, French and Spanish and a study of students' judgment of their own quality of work were among the more technical papers. The development of an individualized program of science instruction was presented by P. N. Powers and W. C. Van Deventer, who outlined techniques for handling relatively large numbers of students with due respect to their individual differences. An experimental demonstration over a three-year period of the possibility of salvaging considerable numbers of potential failures in freshman mathematics at Purdue University was presented by D. R. Shreve.

The joint session with the Section on Psychology was devoted to a symposium on "The Psychology of Learning and the Educative Process." Those invited to participate in the symposium presented a notable program. Both explicitly and implicitly the thesis that the problems of psychology and of education are ultimately the same was ably supported. A particularly significant research was that of the effect of diet on learning by Harold F. Clark and M. F. Seay, who reported on some of the major effects of an experiment being carried on in 29 communities throughout the United States with startling increases in the rate of learning through improved diet and more effective learning materials. The relative effects of these two factors will, under the experimental design, be isolable when the experiments are completed.

At the joint dinner of Sections I and Q the retiring vice president for Section Q, E. J. Ashbaugh, ably reviewed the difficulties of a child who has to learn to read English. The title of his address was "Education as Science and Art." The retiring vice president for Section I, Karl M. Dallenbach, presented a most scholarly historical and experimental review of the temperature senses in a paper entitled, "The Temperature Senses: Their History and Present Status."

THE SOCIETY OF SIGMA XI

(From report by George A. Baitsell)

The 42nd annual convention of the Society of the Sigma Xi met at 4 P.M. Tuesday, with 49 chapters and 14 clubs represented by delegations of one to three members.

Charters for chapters of Sigma Xi were granted to the University of Hawaii, Illinois Institute of Technology, Louisiana State College and Utah State Agricultural College.

The Committee on Lectureships reported a series of five lectures, with engagements at 68 institutions.

The 20th annual Sigma Xi lecture, under the joint auspices of the A.A.A.S. and Sigma Xi, was given in the McFarlin Auditorium on the Southern Methodist University campus by Dr. Edwin P. Hubble, of Mt. Wilson Observatory, on the subject "The Expanding Universe Theory."

Officers were elected as follows: *President,* Ross A. Gortner; *member of executive committee for 5-year term,* Fernandus Payne; *member of the alumni committee for 5-year term,* Paul R. Heyl.

UNITED CHAPTERS OF PHI BETA KAPPA

Dean Christian Gauss, of Princeton University, delivered the seventh annual lecture presented at annual meetings under the auspices of the society and the association on "Can We Educate for Democracy." Both the subject and the treatment of it reflected the searching examination of fundamentals respecting the organization of society that is being made today.

THE AMERICAN SCIENCE TEACHERS ASSOCIATION

The society held two sessions and a luncheon, at which Dr. Irving Langmuir, president of the A.A.A.S., delivered an address. At the first session, held jointly with the American Nature Study Society, 4 papers were presented on various aspects of nature study. The second session, also held jointly with the American Nature Study Society, was devoted to a symposium on "Science in the Service of Youth in a Democracy," following which the prize-winning papers of the junior academy of science in Texas were announced.

THE AMERICAN NATURE STUDY SOCIETY

In addition to the two joint sessions with the American Science Teachers Association, the society held one session on December 31 for the presentation of 4 papers and a session for sound motion pictures of snapping turtles and sunfish, and phonograph records of bird songs, both presented by E. Laurence Palmer.

HONOR SOCIETY OF PHI KAPPA PHI

Homer P. Rainey, president of the University of Texas, delivered the third annual lecture on "Scholarship is not Enough." In addition, the society held a breakfast and business session on December 31.

SIGMA DELTA EPSILON, GRADUATE WOMEN'S SCIENTIFIC FRATERNITY

The society held a luncheon on December 30 at which Ercel Eppright, director of home economics at Texas State College for Women, delivered an address on "Texas Foods, Yesterday and Today." In addition the society held a breakfast and business session.

TEXAS ACADEMY OF SCIENCE

The Division of Geological Sciences (C. L. Baker, *vice president*) held two joint sessions with the Section on Geology and Geography (E) and the Geological Society of America on December 29, at which 17 papers were presented (report of Section E). The Division of Social Sciences (T. H. Etheridge, *vice president*) held a joint session on December 29 with the Section on Social and Economic Sciences (K), at which 3 papers were presented (report of Section K). The Collegiate Division (J. C. Godby, *chairman*) held sessions on December 29, at which 9 papers were presented. The Junior Division (Emily Barry Walker, *chairman*) held a morning session on December 31 on problems relating to junior academies and science clubs. The afternoon was devoted to the final contest of the Chicago apparatus award.

MINUTES OF THE MEETING OF THE COUNCIL

(*From report by Otis W. Caldwell, secretary*)

1. The American Society for X-ray and Electron Diffraction and the American Association of Cereal Chemists were accepted as affiliated societies; the Wilderness Society was accepted as an associated society.

2. The election of members to fellowship were distributed among the sections as follows: B, 1; F, 4; G, 9; H, 1; I, 42; L, 2; N, 1; Nd, 3.

3. The names of officers elected were published in SCIENCE, January 9, 1942, pages 39 and 40.

4. The following members were elected "emeritus life members" under the provisions of the Jane M. Smith Fund: B. M. Duggar, Alexander W. Evans, Peter Fireman, William McPherson, Karl M. Wiegand and Charles B. Davenport.

5. The following were elected "emeritus annual members" under the Luella A. Owen Fund for the fiscal year ending September 30, 1942: Clarence P. Gillette, Frederick J. Wulling, James C. Graham, Samuel M. Lindsay, Elmer O. Wooton, Morton J. Elrod, Frederick C. Waite and Milton Bennion.

6. Approval was given to the following places and dates for holding annual meetings, provided general conditions are not such that the meetings would be inadvisable:

City	*Date*
Ann Arbor, Mich.	June 22–26, 1942.
New York, N. Y.	Dec. 28, 1942, to Jan. 2, 1943.
Cleveland, Ohio	Dec. 27, 1943, to Jan. 1, 1944.
Atlantic City, N. J.	Dec. 27, 1944, to Jan. 2, 1945.

7. The following summary report covering membership was presented by the Permanent Secretary:

	1937	*1938*	*1939*	*1940*	*1941*
Membership (Dec. 20)	18,777	20,050	20,366	21,050	23,122
Paid members (Dec. 20)	13,145	14,694	14,781	15,867	16,969
One year arrears					

(Dec. 20)	4,968	4,674	4,861	4,983	5,257
Two year arrears (Dec. 20)	664	682	724	700	896
Resignations and deaths (Dec. 20)	245	288	278	274	313
Reinstatements (Oct. 1–Dec. 20)	28	18	18	13	18
New members (Oct. 1–Dec. 20)	1,181	1,500	903	729	2,169

(On January 15, 1942, the total enrolment was 23,701. Between October 1, 1941, and January 15, 1942, 2,748 new members were added to the membership roll.)

8. The following financial reports are summarized from audited statements which were accepted by the Council:

FINANCIAL REPORTS

TREASURER'S REPORT

Balance Sheet—Assets at September 30, 1941

Securities and mortgages	$152,819.77
Cash awaiting investment	120,149.91
Cash for current needs	15,869.31
Total assets	$288,838.99

Balance Sheet—Liabilities at September 30, 1941

Endowment—for research (1)	$117,911.45
Endowment—for general purposes (2)	92,197.88
Endowment—dues for emeritus life members (3)	5,000.00
Endowment—dues for emeritus annual members (4)	500.00
Reserve fund	44,022.19
Permanent Secretary's fund	13,338.16
Prize fund	2,000.00
Grants to affiliated academies	560.00
Accumulated income for appropriation in 1942	13,309.31
Total liabilities	$288,838.99

(1) Richard T. Colburn fund, $87,186.45; fees of deceased sustaining members, $7,000; fees of deceased life members, $20,200; A. G. Stillhamer fund, $3,525.

(2) W. Hudson Stephens fund, $4,381.21; Michael P. Rich fund, $10,000; Hector E. Maiben fund, $27,357.67; Friends of the Association fund, $3,559; Jennie M. Arms-Sheldon fund, $1,000; fees of living life members, $45,900.

(3) Jane M. Smith fund, $5,000.

(4) Luella A. Owen fund, $500.

CASH STATEMENT

Receipts

Balance, September 30, 1940	$ 60,963.43
Life membership fees	1,300.00
Grant returned and miscellaneous refunds	235.00
Contribution to Prize Fund	1,000.00
Sale and redemption of securities	124,677.92
Interest accumulated during fiscal year	8,865.86
Total receipts	$197,042.21

Disbursements

Securities purchased	$ 52,919.04
Grants-in-aid of research	2,121.45
Grants to affiliated academies	2,625.00
For new emeritus life members	600.00
For emeritus annual members	21.50
Life members' journal subscriptions	1,614.00
Fifty-year members' journal subscriptions	78.00
Thousand Dollar annual prize	1,000.00
Miscellaneous expenses	44.00
Total disbursements	$ 61,022.99
Cash on hand, September 30, 1941	136,019.22
	$197,042.21

PERMANENT SECRETARY'S REPORT

Balance Sheet—Assets at September 30, 1941

Cash in banks	$ 19,989.08
Reserve in Treasurer's hands	13,338.16
Accounts receivable	378.54
Supplies on hand	1,811.26
Deferred charges	4,550.34
Total assets	$ 40,067.38

Balance Sheet—Liabilities at September 30, 1941

Advance payments of dues, etc.	$ 1,070.85
Special committee funds:	
Place of Science in Education	308.53
Popular Science Reading Lists	206.35
Permanent Secretary's cash reserves	32,812.36
Balancing account	5,669.29
Total liabilities	$ 40,067.38

INCOME STATEMENT

for the Fiscal Year Ended September 30, 1941

Income

Annual dues and fees	$ 99,823.84
Interest on bank accounts	616.76
Miscellaneous receipts	1,714.25
Registration fees—Philadelphia meeting	3,154.00
Registration fees—Durham meeting	322.00
Receipts from Philadelphia Exhibition	7,411.00
	$113,041.85

Expenses

Subscriptions to journals, including foreign postage	$ 61,651.59
Expenses of Washington office	24,014.60
Expenses of General Secretary	510.33
Allowances to Pacific and Southwestern Divisions	2,566.00
Circularizing for new members	3,368.56
Miscellaneous expenses	689.53
Expenses of Philadelphia Exhibition	3,965.21
General and travel expenses—Philadelphia meeting	4,942.00
General and travel expenses—Durham meeting	802.19
General and travel expenses—Chicago meeting	391.96
	$102,901.97
Balance	10,139.88
	$113,041.85

REPORT OF THE COMMITTEE ON GRANTS

Upon recommendation of the Committee on Grants, consisting of Drs. S. A. Mitchell, *chairman*, J. T. Buchholz, Henry Crew, Vincent du Vigneaud, T. R. Hogness, W. S. Hunter, G. H. Parker and A. H. Schultz, the council of the association awarded grants-in-aid amounting to $1,791.89 as follows:

Helen Purdy Beale, for a study of the photoelectric titration of plant viruses, $125.

Arthur N. Bragg, for a study of the ecological factors and habits limiting distribution of Anuran Amphibians together with a study of Isolating Mechanisms, particularly at times of breeding, $116.89.

E. P. Mumford and G. D. Hale Carpenter, for a study of faunal distribution with particular reference to oceanic islands, $100.

Ernst Caspari, for a study of the inheritance and gene physiology of testis coloration in *Ephestia kutmiella* Z., $125.

E. R. Eller, for an investigation of the scolecodont fauna and stratigraphic interpretation of the Trenton Limestone of Ontario, New York and Pennsylvania, $300.

Lillian N. Ellis, for a study of the mechanism of the sparing action of Riboflavin on Thiamin, $150.

Douglas G. Ellson, for a study of the relationship between available measures of auditory acuity and an intensity threshold for the perception of speech in context, $300.

Martin A. Entin, for an investigation of cell physiology of mammalian carcinoma and studies of living cells using tissue culture technique, $150.

John P. Foley, Jr., and Charles N. Cofer, for a study of certain problems in the application of conditioned response principles (mediated generalization) to verbal behavior, $325.

Eric Ponder, for a study of the action of capillary poisons, $100.

SCIENCE EXHIBITION

Agricultural and Mechanical College of Texas: (1) Division of Swine Husbandry, (2) Division of Animal Husbandry, (3) Division of Agronomy, (4) Division of Plant Pathology and Physiology, (5) School of Engineering and Department of Physics; American Association of Petroleum Geologists; American Association of Scientific Workers; Bausch and Lomb Optical Co., Rochester, N. Y.; Biological Abstracts, University of Pennsylvania; The Blakiston Co., Philadelphia, Pa.; Central Scientific Co., Chicago, Ill.; The Dallas Petroleum Geologists; The Eastman Kodak Co., Rochester, N. Y.; The General Electric Co., Schenectady, N. Y.; The Gradwohl School of Laboratory Technique, St. Louis, Mo.; The Linguaphone Institute, N. Y.; Kansas Agricultural Experiment Station; The Macmillan Co., New York; McGraw-Hill Book Co., New York; Metric Association; National Geographic Society, Washington, D. C.; North Texas Biological Society; North Texas State Teachers College, Department of Chemistry; University of Oklahoma, Department of Botany; Prentice-Hall, Inc., New York; W. B. Saunders Co., Philadelphia, Pa.; Science Clubs of America; The Science Library; The University Presses, A Cooperative Exhibit; The South-Western Biological Supply Co., Dallas, Texas; Spencer Lens Co., Buffalo, N. Y.; Texas Power and Light Co., Dallas, Texas; John Wiley & Sons, Inc., New York; The University of Texas, Austin, Texas; The University of Texas, Department of Physiology; Tulane University of Louisiana, Department of Tropical Medicine; RCA Manufacturing Co.

In the report sent to the daily press by Science Service it is remarked that progress of science during 1941, despite threats of war and final sudden outburst of war itself, was strikingly set forth in the annual exhibition of the American Association for the Advancement of Science, shown in connection with the Dallas meeting. Many universities, research institutions and industrial firms cooperate annually in this display of the latest results of research.

Oil, indispensable alike in war and peace, is one of the chief products of the region where this year's meeting was held, so that a demonstration of modern scientific oil prospecting methods, by the American Association of Petroleum Geologists, fittingly occupied a prominent place in the exhibits. By models and charts it demonstrated how geologists feel their way through hundreds of feet of solid rock and shifting sand, to where the oil is.

How science also aids in providing more and better food and clothing, to meet the increased needs of war and the post-war world, was demonstrated in several booths set up by the Texas Agricultural and Mechanical College. Colchicine, the evolution-speeding chemical, has been applied to the cotton plant, to make it produce bigger bolls and oilier seeds. Some of the husky new cotton plants were exhibited, growing in pots, contrasting with their punier untreated relatives that stand beside them. Science helps cotton below ground as well as above; another part of the exhibit demonstrated advances in combatting the fungus-caused root rot, one of the worst of cotton diseases.

Dissemination of scientific knowledge, as well as its increase through research, claimed its share of attention. A recently formed organization of professional scientists, the American Association of Scientific Workers, devoted its exhibit to a demonstration of its work in aiding defense, morale and national health; preserving science and freedom of thought in war time; educating the scientists themselves in problems that involve social welfare.

A booth was maintained by *Biological Abstracts*. Scanning and boiling down to a few sentences each the technical articles in more than 1,400 scientific journals, this publication saves the time of busy research workers.

Science is not exclusively an affair for professionals. That the tradition of the serious amateur, established in America by Franklin and Jefferson, Rittenhouse and Priestley, still carries on valiantly was evidenced by the exhibit of the Science Clubs of America. This is a national organization of hundreds of school and adult clubs composed of persons young and old who devote their spare time to scientific pursuits, ranging all the way from the study of the ways of frogs and field-mice to the making of telescopes and their use in discovering comets and watching variable stars. Science Service, which serves as liaison agency for these clubs, displayed some of its publications and the monthly specimen-service known as Things of Science.

BOOKS RECEIVED

Advances in Colloid Science. Elmer O. Kraemer, editor. Volume I. 161 Illustrations. Pp. xii + 432. Interscience.

Four Treatises by Paracelsus. Henry E. Sigerist, editor. Translated from the German by Sigerist and Others. Pp. xii + 256. Johns Hopkins Press. $3.00.

Coleman, Laurence Vail. *College and University Museums.* Illustrated. Pp. viii + 73. American Association of Museums. $1.25.

Leyson, Burr. *It Works Like This.* Illustrated. Pp. 224. E. P. Dutton. $2.50.

Markham, Edwin C. and Sherman Smith. *General Chemistry Problems.* Pp. 240. Reynal and Hitchcock. $1.25.

Merriman, Gaylord M. *To Discover Mathematics.* Pp. xi + 435. Wiley. $3.00.

Papers on Mammalogy. Published in honor of Wilfred Hudson Osgood. Volume 27, Field Museum of Natural History Zoological Series. 12 Plates. Pp. 395. Field Museum. $3.00.

Roebuck, John R. and Henry C. Staehle. *Photography, Its Science and Practice.* Illustrated. Pp. xv + 283. D. Appleton-Century. $5.00.

Unger, W. Byers and C. E. Moritz. *A Laboratory Manual for Elementary Zoology.* Pp. iv + 102. Ginn. $1.25.

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DROSOPHILA AND SPECIATION[1]

By Dr. J. T. PATTERSON

PROFESSOR OF ZOOLOGY, UNIVERSITY OF TEXAS

ONE of the duties of the office of vice-president, if not the only one, is that of giving the address on the occasion of the annual Zoologists' dinner. Examination of a number of the papers which have been read by my predecessors in office shows that the speaker has entire freedom in the selection of his subject and the method of its presentation. The several addresses which were examined deal with various topics, with some enlivened by much subtle humor and others revealing evidence of serious efforts to plumb the depths of the philosophy of biology. For me it seems safer to pursue a middle course.

I have selected for discussion a subject which, although venerable, is still capable of holding the attention of biologists. It is now more than eighty years since Charles Darwin posed the question of the origin of species, but until recently we did not have experimental proof of the exact method by which a given animal species might have arisen among wild populations. Following the appearance of Darwin's classical work, and prior to the development of the modern theory of Mendelian inheritance, most investigators were concerned with the problem of establishing the fact of evolution. They used largely the descriptive methods of comparative anatomy, embryology, paleontology and taxonomy coupled with geography. All this work was fundamental and important, but it left the main question raised by Darwin's conclusions still unanswered as it did not elucidate the *modus operandi* of species origin and differentiation.

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[1] Address of the retiring vice-president and chairman of the Section for the Zoological Sciences of the American Association for the Advancement of Science, Dallas, Texas, December 30, 1941.

This was the situation at the turn of the century with reference to the origin of species. Then, with the rediscovery of Mendelism, there followed a very rapid development in the fields of cytology and genetics, with the early deduction that chromosomes and hereditary factors could be definitely correlated. The final triumph of this deduction was brought about through the investigations of Morgan and his co-workers on the most common of the fruit-flies, *Drosophila melanogaster*. These studies resulted in the erection of a complicated system of genetic research which centers on the gene as the determiner of hereditary characters. As the system became more and more complicated, the fear or the hope, depending on the outlook of the commentator, was expressed that the whole structure was in danger of falling of its own weight; but, like the Leaning Tower of Pisa, it still stands.

The technical methods developed in connection with this work on *Drosophila* are indispensable for an analysis of the problem of the origin of species. In recent years two additional technical advances have been made which are of great importance. The first of these was Muller's demonstration that x-rays could be used as a means of inducing mutations and chromosomal rearrangements, and at a rate far exceeding that which occurs in untreated organisms. This method has made it possible to study in great detail various kinds of rearrangements, such as translocations, inversions, duplications and deficiencies, and has resulted in enriching our knowledge of the effects of such changes on genotype and phenotype.

The second advance was made by Painter's development of the salivary-gland chromosome technique and his demonstration that the bands of these giant elements precisely follow the sequence of loci of known mutant genes as revealed on the "genetic maps" of *Drosophila*. This technique is a very rapid and convenient method for detecting changes in chromosome structure, whether they have been produced by artificial means or have occurred spontaneously in wild populations.

Coincident with this development of technical methods, there has occurred a rapid advancement in the application of mathematics to the problem of evolution. In this connection the work of Professor Sewall Wright, in showing some of the evolutionary consequences of Mendelian inheritance, is especially noteworthy.

In the meantime, some very interesting investigations have been made on the relation of environment to evolution, especially on plants, which are more suitable for such studies than are most animal forms. Time will not allow for more than a brief reference to a recent publication by Clausen, Keck and Hiesey.[2] They experimented with a large number of the higher plants, selected from among many unlike species and families and taken from a wide range of habitats.

Their main experiment consisted in dividing the clone and planting the clone members in three different habitats or experimental gardens, located respectively at elevations of 100, 4,600 and 9,000 feet, in a transect across the central part of California. Here the plants were allowed to grow for several years and the changes arising in them under the different environmental conditions were noted and recorded. The first of their several general conclusions is as follows:

> The individual plant is subject to the interplay between heredity and environment. When grown under different environments it may be quantitatively changed in various degrees. The changes induced by a new environment give no evidence of permanence, but have been shown to be reversible modifications. Some of these changes in vegetative characters are quite spectacular, yet they never obscure the individuality of the plant, which is retained irrespective of the conditions of altitude, light and moisture in which the plant is grown.

This work shows that while environmental factors can induce modifications in phenotype, yet they do not change the genotype. It is clear that attempts to solve the problem of the origin of species must be attacked by genetic and cytological methods in a sexually reproducing diploid organism like *Drosophila.*

MATERIAL REQUIRED FOR THE PROBLEM

The series of technical methods outlined above are chiefly genetic and cytological in character and constitute a set of tools with which to attack the problem of speciation. But after all, they are tools and other requirements must be met if the problem of the origin of species is to be satisfactorily solved. One of the most important of these is the choice of material. The group of organisms selected for study should, among other requirements, meet the following conditions:

First, they should belong to a genus with many species living under a variety of environmental conditions and capable of being cultured in the laboratory. They should also be amenable to detailed genetic analysis, so that quantitative data on their genic differences can be obtained. Short life cycle and high fecundity are other desirable traits.

Second, the group selected should possess a relatively low number of chromosomes, and these should be large enough to permit accurate study and analysis. The dense metaphase chromosomes, usually devoid of any distinguishable morphological features, are not satisfactory.

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[2] Carnegie Inst. of Wash. Pub. No. 520, 1940.

Third, the several species should not only occupy different ecological niches, but they should also exhibit a wide range of conditions of size, density and distribution of their populations. Otherwise, it would not be possible to test the relation between population type and genic variation.

Fourth, some of the forms within the group should be capable of producing hybrids, and at least some of these hybrids must be fertile, in order that the genetic mechanism underlying their isolation and differentiation can be determined. This last condition is not easy to realize among animal forms.

The group of forms which would seem to meet all these exacting requirements is to be found in the genus *Drosophila*. It is for this reason, perhaps, that several different workers have recently become interested in this line of investigation, especially Sturtevant, Dobzhansky, Spencer and our own group here in Texas.

It seems surprising that work of this nature on the genus has been so long delayed, but this is due undoubtedly to a failure to secure fertile hybrids at an earlier time. As late as 1934 only two cases of hybrids had been reported. The first of these was found by Sturtevant in 1920 and involved crosses between *D. melanogaster* and *D. simulans*, two closely related species. Unfortunately the hybrids from this cross are completely sterile. The second case of interspecific hybridization in the genus was not found until nearly a decade later (1929), when Lancefield reported that *D. pseudoobscura* was represented by two races or physiological species. He found that crosses between these two races produce partially fertile females and sterile males. Since then, and especially during the last few years, the number of cases of fertile hybrids in the genus has gradually been increased, so that the lack of such hybrids is no longer a handicap.

DROSOPHILA IN THE SOUTHWEST

We had reasons for supposing that southern United States, and especially the southwestern area and northern Mexico, would be an excellent region in which to collect *Drosophila* species for use in the study of this problem. Accordingly, in 1938 we began collecting the wild strains in Texas, and since then have covered most of the southern states and parts of northern Mexico. To date this region has yielded a total of 97 species of the subfamily *Drosophilinae*. Twelve of these species belong to non-Drosophila genera and will not be considered further. Of the 85 species belonging to the genus *Drosophila*, 81 came from the Southwest and northern Mexico.

A detailed morphological study of these 85 species makes it possible to arrange a large majority of them into natural groups or "species groups," each composed of two or more closely related forms. Through such studies we have established twelve species groups which include 67 species. Thus far we have not found a closely related form for any of the eighteen unassigned species, but it is probable that further collecting in this and other areas will bring to light some such forms.

I am emphasizing the groups because they constitute the material units within which the tests for species origin must be made. Indeed, it is within the group that one may expect to find the production of hybrids. Cross tests carried out between species selected from different groups have thus far failed to produce hybrids, and this is true even when the forms used for the test come from groups obviously closely related. Moreover, various types of population are to be found in different species groups, such as those with dense populations as compared with those having sparse populations. Again, the members of some groups have small, dense populations with wide-spread distribution. All these different types must be thoroughly studied if faulty conclusions are to be avoided.

The groups are also important for purposes of chromosome analysis. The fact has long been known that the basic diploid number for the genus is twelve, consisting of five pairs of rod-shaped elements and a pair of small chromosomes which are usually referred to as dots. One notable characteristic in some groups is that the X chromosomes are distinctly longer than the autosomes, and that the Y chromosome may vary in size and shape—from a short to a long rod, or from a J to a V. Within the groups, variations in the number of arms in metaphase have been found to be due either to a fusion of two rods, or to an inversion or insertion which has shifted the centromere from its position close to the end to one nearer the middle. This results in changing the chromosome from a rod to a J- or V-shaped element. My coworker Griffen has found that this is true for all cases thus far examined for any given group.

Within the group, where hybrids are obtainable, the salivary chromosome furnishes the only means whereby a highly detailed analysis and comparison of chromosome organization can be made between different species. The structural features of these elements make it possible to use them as tracers in following out the distribution of a particular chromosome or its parts within the population, like the use of radioactive tracer atoms in following out the distribution of substances within the body. This method has been used by Sturtevant and Dobzhansky in their studies on *pseudoobscura* and *miranda* and we have extensively employed it in our own work.

Some of the twelve species groups have been investigated in other laboratories. We have been working on seven of them, and they furnish considerable material upon which to base some general conclusions concerning the origin of species in the genus Drosophila. To make this clear it will be necessary to refer again to some of the facts given in my symposium address, but these repetitions will be reduced to the minimum.

If mutational changes lie at the basis of organic diversity, it should be possible to demonstrate the mechanism involved through suitable tests and careful cytological observations. Unless the genetic mechanism of organic evolution is to remain a mere hypothesis, it will be necessary to do this on wild populations. Various questions have been raised concerning the nature of this mechanism. Our own studies afford answers to some of these questions.

One of the essential differences between animal species is the fact that they usually do not attempt to cross. This reluctance or refusal to mate has been termed sexual isolation. Our results show that this type of isolation is due to genetic factors which operate both between species and within a species. In the single species, *Drosophila repleta,* Wharton has made cross tests with strains collected at different points in Texas, Eagle Pass, Elgin, Fredericksburg and Galveston, and with stocks from New Haven, Connecticut, Guatemala, Central America, and Ankara, Turkey. Her results show that while matings between certain strains either fail to go or go very rarely, yet the reciprocal crosses are very successful, producing offspring which are highly viable and fully fertile. A few examples may be cited.

The cross between Ankara males and either Fredericksburg or Guatemala females is practically sterile, while the reciprocal crosses are highly fertile. Again, New Haven males are sterile to Fredericksburg and Guatemala females, but fully fertile to Eagle Pass and Elgin females. In the reciprocal crosses, New Haven females are fully fertile to Fredericksburg and Eagle Pass males, slightly fertile to Guatemala males and sterile to Elgin males.

The failure to produce offspring in many of these crosses is due to sexual isolation. This was proved by examinations of the reproductive tracts of the females, which in no case of cross-sterile matings contained sperm. If successful mating has occurred, sperm can always be detected. A study of the salivary-gland chromosomes of the F_1 larvae shows that the sterility is not associated with major chromosomal rearrangements. The complexity of the cross-sterility relations indicates that sexual isolation depends on different factors in the several strains. These factors are autosomal recessives because the heterozygotes are fully fertile and exhibit hybrid vigor. Despite this isolation, the different strains can not be regarded as separate species. This same type of isolation has been encountered in all the species groups which we have studied, and in the virilis group at least some of them are also due to autosomal recessive factors.

While sexual isolation must play an important rôle in species differentiation, yet it is doubtful whether it alone would be a sufficient mechanism. There is always the possibility that this barrier to crossing might occasionally break down and thus permit an exchange of genes within the population. It was therefore not surprising to find additional isolating mechanisms present within differentiating species groups.

THE MACROSPINA GROUP

A very fine example of multiple mechanisms in operation is to be seen in the macrospina group. There are at least four detectable mechanisms present in this group. These are sexual isolation, hybrid sterility, a sex chromosome unbalance and the passive factor of geographical separation. Geographically, the several forms may be separated into three divisions. In California there is a single species which has been described by Spencer as *Drosophila subfunebris.* The second divisional group is composed of a series of strains taken in Sonora, Mexico, southern Utah, Arizona, New Mexico and west Texas. The numerous strains probably all belong to a single subspecies of *D. macrospina* which is known as *limpiensis.* The third divisional group is composed of another series of strains which have been taken from central Texas eastward to Florida and northward to Ohio. These strains may also constitute a single subspecies known as *D. macrospina macrospina,* although Spencer regards the Ohio strains as different from the type material from Texas and has designated them as the subspecies *ohioensis.* The three groups will be referred to as *subfunebris, limpiensis* and *macrospina.*

If a series of cross tests be carried out between the different members of this group by starting with *subfunebris* of California and progressing eastward, a very interesting set of facts become revealed. The cross between *subfunebris* and its nearest *limpiensis* neighbor in Utah goes rather readily in both directions, producing fertile female hybrids and sterile male hybrids. In matings of *subfunebris* to a New Mexico strain of *limpiensis* the cross again goes both ways, but owing to the operation of sexual isolation, it takes twice the normal time of ten days for the larvae to appear in the culture when *subfunebris* is used as the female parent. The cross between *subfunebris* and a strain of *limpiensis* from west Texas goes but one way, producing only a few progeny and requiring from twenty-five to thirty-five days for the larvae to appear. Finally, in the cross between *subfunebris* males and *macrospina* females from central Texas, a small number of the mated pairs produce offspring, with about thirty days required for the larvae to appear in the culture.

If the tests are to be extended beyond central Texas, crosses between *limpiensis* and *macrospina* must be used, because *subfunebris* is completely sterile to all strains of *macrospina* coming from east of central Texas. Crosses between all *macrospina* strains and those of *limpiensis* go in both directions and produce the normal number of progeny, although when *limpiensis* is used as the female parent the male hybrids are either sterile or semi-sterile, depending upon the strain used in the cross. Mainland has shown that this particular type of sterility is due to a genic unbalance between the X and Y chromosomes.

In each cross where the two strains selected are from adjacent areas an exchange of genes occurs. Hence, it would be possible to carry this exchange in steps across the country in either direction, and this would bring about an exchange of genes between the otherwise completely isolated species of *D. subfunebris* and *D. macrospina*.

THE MELANICA GROUP

The melanica species group has three known species: (1) *Drosophila melanica,* which occurs principally in the northern states and from which area we have strains from Wisconsin, Ohio, Maryland, Connecticut and Massachusetts; (2) *D. submelanica,* which ranges across southern United States and extends northward into the Ozarks; and (3) *D. nigromelanica,* which is found in both the North and South along with the other two forms. Extensive breeding tests have been carried out on this group by Dr. A. B. Griffen.

Males from the Wisconsin strain of *melanica* are only slightly cross-fertile to *submelanica* females. The reciprocal cross was found to be completely sterile, with but one exception, and that was the cross between Wisconsin females to Ozark *submelanica* males, which goes but slightly. Madison males of *melanica* go slightly with *nigromelanica* females from Texas. Otherwise, among northern forms, the only *melanica* strain which is cross-fertile to *nigromelanica* was one from Maryland of which the females are poorly cross-fertile to the males of the Wooster strain from Ohio. All *submelanica* strains are completely cross-sterile to all *nigromelanica* strains, irrespective of their geographical origin. The metaphase chromosomes of all three species are alike, but the salivary-gland chromosomes of the hybrid larvae show several conspicuous inversions.

The degree of fertility in the intial crosses is always small and usually amounts to less than one per cent. These three species are almost completely isolated, but in contrast to the *macrospina* group, the isolation is between the parent forms and is not due to hybrid sterility, because all hybrids are fertile.

THE MULLERI GROUP

The first species group which we found in Texas was that of *mulleri*. It is especially interesting in that it exhibits at least six different types of isolating mechanisms. In addition to sexual, geographical and ecological isolations, and hybrid sterility, it shows two different types of zygotic mortality. There are probably as many as seven species which belong to this group. Crow has tested five of these species. These are, *Drosophila mulleri* Sturtevant, found mainly in Texas; *D. aldrichi,* which occupies much the same distribution area in Texas as *mulleri; D. mojavensis* from the deserts of California; *D. arizonensis* from Arizona; and *D. buzzatii.* of which single stocks are available from Argentina and Sicily.

Crosses between the several members of the group produce an unusual series of interspecific hybrids, of which only three are fertile. The main results were as follows: *Mulleri* females are cross-fertile with males of the other four species, but the reciprocal crosses are all sterile. The number of hybrids produced in each cross was small and the only fertile hybrids were the F_1 females from the cross with *mojavensis* males. The mating with *buzzatii* males gives highly abnormal flies which almost invariably die in the pupal stage. *Aldrichi* females are cross-fertile with either *mojavensis* or *arizonensis* males, producing sterile females in each case. The cross between *mojavensis* and *arizonensis* goes in both directions, producing fertile male and female hybrids when *mojavensis* is used as the female parent, and sterile male and fertile female hybrids in the reciprocal mating. *Arizonensis* females are also cross-fertile with *buzzatii* males, but the resulting hybrid larvae never develop as far as the pupal stage.

From these facts it is clear that *buzzatii* is almost completely separated from the other four species, with *aldrichi* next in order. *Mojavensis* and *arizonensis* are the most closely related species, and some workers might be inclined to regard these as subspecies.

The second type of mechanism which causes the death of the hybrid zygote was discovered by Crow while making crosses between *mulleri* and certain strains of *aldrichi*. These two species both have dense populations and occupy a common distribution area in Texas. They are completely isolated from each other by sexual isolation and hybrid sterility, and have a certain amount of ecological isolation. *Aldrichi* is almost entirely dependent on the common prickly pear as a source of food and as a medium for the developing larvae, while *mulleri* can and does feed and breed on various other kinds of fruit.

When *mulleri* females are crossed to males of a certain strain of *aldrichi* the hybrid offspring are predominantly male. This modification of the sex-ratio is due to the lethal effect on the female zygote of a sex-linked gene (or genes) on the X chromosome of *aldrichi*. This factor has no noticeable effect within the species, but acts as a dominant semi-lethal in the interspecific cross. The net effect is the elimination of about one half of the hybrid zygotes. In species already genetically isolated from each other, it could have little advantage to the parent populations other than that of removing the competition from the hybrids.

THE VIRILIS GROUP

In many ways the virilis group is the most interesting which we have studied, and perhaps the most significant. It includes five known species. The first of these is the original form described by Sturtevant in 1916 under the name *Drosophila virilis*. The second is *D. americana* found by Spencer in 1936 in Ohio. The other three, all new to science, have been discovered by us in the last four seasons. These are *D. texana*, first taken in Texas, *D. novamexicana* from southern New Mexico and *D. montana* from the Rocky Mountain system of Colorado, Wyoming, Utah and New Mexico.

These five species show both geographic and genetic isolation to a rather high degree. On the basis of our collection records, *novamexicana* and *montana* appear to be completely isolated geographically from the other three species, and while the distribution ranges of *texana* and *americana* overlap to a certain extent, yet in the main the two species occupy different regions, *texana* being confined to the southern states and *americana* occupying an area centering in Ohio. The main distribution area of *virilis* coincides very closely with that of *texana*, but by virtue of a difference in habitats, the two species have effective ecological isolation. *Virilis* lives and breeds in stores and produce houses in a domestic-type of habitat, while *texana* lives and breeds in the woods in a wild-type habitat.

The question of genetic isolation between the several species has been discussed elsewhere at these meetings and need not be considered further here. I wish, however, to refer briefly to their chromosomes. All five species differ from one another, either in chromosome number or in the inversions present, or in both. These differences are such that one can trace the evolution of chromosome morphology in the population, and by this means we have been able to show that *americana* evolved from hybrids between *novamexicana* and *texana*. The character of the inversions in the different strains indicates that *americana* is not a homogeneous species, for its population still contains several of the possible combinations of chromosomes of the two parent species. This chance to work out the direction of evolution in the origin of this species is striking proof of the efficacy of the salivary-gland chromosome technique. As all the chromosomes differ in gene order from one another in the parent species, recombinations would occur in the descendants of their hybrids. Different strains of *americana* show a limited number of these combinations. The original strain from Smithville, Ohio, for example, has chromosomes 2, 3, 5 and Y of *texana* and X and 4 of *novamexicana*, while another stock from Ohio, known as Pee Wee, differs in having the *texana* type of the male sex-limited fourth chromosome. Still other combinations have been found in different strains.

While it is difficult to determine just where the original hybridization took place, yet there is some evidence to indicate that it occurred here in the Southwest. *Novamexicana* has been found in southern New Mexico and the distribution of *texana* extends from central Texas to the Atlantic seaboard. It is probable that at one time the distribution areas of the two populations overlapped at some point in the intervening region, which would have given the opportunity for the hybridization to occur. Wherever the exact place was, it is clear that once the new species was produced it expanded northeast into a new ecological area in and about the state of Ohio, leaving behind over the trail of its progress some of the combinations which are still to be found associated with *texana*.

DISCUSSION AND CONCLUSION

Most of the investigations of the different workers on these species groups have been concerned with the extent of, and the reasons for, their isolation. As shown above, and especially in my symposium address, various types of isolating mechanisms are present either singly or in combinations among the different groups. Their net effect is the partial or complete elimination of the exchange of genes between populations. Except for simple geographic isolation, these limiting mechanisms are due to gene mutations. Other mutations are responsible for the great variety of morphological and physiological characteristics, and in relation to the isolating mechanisms and the restrictions on gene recombinations imposed by chromosomal rearrangements, form the basis for diversification both within and between species.

It might be well to compare some of these diverse characteristics as they appear in the different members of the species groups. In the *mulleri* group, two of the species live together in the same region and are much alike as to size and color pattern, but differ from each other in the color and size of eyes, in food habits and in length of life cycles, and are completely incapable of exchanging genes. In contrast to this, two other members of the group are separated geographically and differ widely in phenotype, but are readily capable of exchanging genes when brought together.

In the virilis group two distinct types are found, one of which lives in a domestic-type of habitat, the other in a wild-type habitat. The two types are therefore ecologically isolated and otherwise differ from each other in a number of morphological and physiological characters. The different strains of virilis, which represent the domestic-type, etherize very slowly, have clear crossveins, pupate on the sides of the container, have pupae which run the entire gamut of color variation from light-tan to deep black, and are fully cross fertile. The four wild-type species all etherize very quickly, have clouded crossveins, pupate in or at the edge of the food, have pupal color which is basically red, and are not fully cross fertile. Even within the wild-type group there are many character differences. Two of these species live in a region of severe winters in the high elevations of the Rocky Mountains and are readily distinguishable from the other two which live in a warmer climate in low wooded areas.

Some species groups are noteworthy for certain types of variation. For example, in the *pseudoobscura-affinis* complex of species extreme modifications of chromosome structure are common between related forms, but with little difference in phenotype. In the *mulleri* group modifications of phenotype are common, but differences in the chromosomes are absent between two of the genetically isolated species. The virilis group is remarkable among animal forms for having a clear case of hybrid origin of one of the species. The distinctness of the species in this group is in sharp contrast to the conditions found in the macrospina group. In the latter a series of genetic changes have accumulated so slowly across the distribution range that only the extreme ends may be regarded as distinct species.

The first of the fundamental problems propounded by Darwin was the question of the fact of evolution. This has been definitely established by a great variety of evidence from many fields of biology and geology. The second question as to how evolution actually operates is only now being elucidated, and toward the solution of this problem the contributions from the several investigations on the Drosophila species groups are playing an increasing role. It is no longer necessary to explain evolution by analogy, for the application of genetical and cytological techniques in this genus proves that it depends on experimentally measurable gene mutations.

STUDIES OF INFANT CHIMPANZEES

By HENRY W. NISSEN

YALE LABORATORIES OF PRIMATE BIOLOGY

ANNOUNCEMENT was made[1] in April, 1940, of an experimental chimpanzee nursery established at the Yale Laboratories of Primate Biology in Orange Park, Florida. The present report describes in greater detail the aims and methods of this program, and includes a brief account of progress to date.

Our primary general purpose in initiating this project was to provide and utilize infant chimpanzees in relatively large numbers as materials of psychobiological research. Heretofore very few specimens under one year of age have been available. Those few provided by dealers were invariably several months old and had limited scientific usefulness because of only approximately known age and ontogenetic history. Most of those born in captivity were, for obvious practical reasons, left with their mothers during the first year of life or longer and were therefore unavailable for anything but casual observation. The development in these laboratories, over the past decade, of a large and healthy breeding colony, gave the first opportunity, which may not soon be repeated, to undertake a relatively extensive study of young chimpanzees during the critical period starting at birth. Generous support by the Samuel S. Fels Fund, covering the special expenses of the project over a five-year period, made it financially possible to institute the program.

By making possible control and experiment, animal research has almost invariably pioneered in widening our biological horizons. The particular advantages of chimpanzees for investigations of characteristically human phenomena are fairly obvious. The extrapolation of discoveries by analogy and the examination of relatively subtle differences (as contrasted to the search for broad principles of wider applicability), both demand a high degree of similarity in research materials. Use of the anthropoids opens the possibility of observing such phenomena in relatively uncomplicated form, tracing their more immediate origins or precursors, and of analyzing what is without doubt the most significant step in mental or behavioral progression to be found within the animal continuum.

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[1] SCIENCE, 91: 336–337, 1940.

The genetic method has proven its worth repeatedly in all fields of biological inquiry; its application in the present instance seems particularly indicated. An ontogenetic study of chimpanzee should not only add meaning to the phylogenetic comparison of the ultimate (adult) characteristics of man and the anthropoid apes, but should open up an entirely new dimension of comparison, that of the dynamics of developmental trends in the two species. It seems not unreasonable to expect that in the finer analysis of these diverging trends will be found essential clues to the critical differences which define the human and subhuman primate.

Two additional but definitely subordinate goals of the project may be mentioned: (1) The captured chimpanzee, purchased from a dealer, usually brings with him a host of intestinal parasites. Some of these parasites can be exterminated without much difficulty; others it is impossible or impracticable to eradicate, especially in larger specimens. Although it is conceivable that the wild chimpanzee does not suffer—perhaps even benefits—from the parasites, it is clear that in captive animals they constitute a hazard and probably affect, to an unknown degree, various life-functions. By removing infants from the adults at birth, infestation is prevented; with the institution of various precautions against subsequent contamination, it is hoped thus to build up gradually a parasite-free colony. (2) By eliminating the period of nursing, which in chimpanzees often persists for as long as two years, a speeding-up of the breeding rate is anticipated; instead of bearing one infant every two or three years, it may be that each breeding female can produce offspring at intervals half that long. This, together with better development and lower mortality of the laboratory-raised infants (as suggested by the record thus far), should increase significantly the number of laboratory-born chimpanzees available for research here and in other institutions.

Since it has been felt that the anthropoid apes could be employed most fruitfully in the investigation of phenomena which are distinctive of the highest primates, and since man is characterized most obviously and significantly by his behavior, the central focus of this program was clearly indicated. Our interest, accordingly, has been and is chiefly in experimental behavior analysis and in the correlation of behavior with underlying morphological and physiological factors. Our view-point, furthermore, dictates emphasis on the so-called higher mental functions (especially those seemingly mediated by symbolic processes), the secondary or derived forms of motivation and the more complicated expressions of emotion as seen especially in social behavior, rather than on relatively simple reactions which are perhaps essentially similar over a broad range of animal life.

It is clearly indicated, however, that approach to these most significant problems must be over the groundwork of preliminary information regarding basic growth phenomena in the species. After developing practicable and reasonably efficient routines for the care and feeding of infant chimpanzees, our first task, therefore, was to gather as large a body of facts as possible on the development of our subjects under these uniform conditions. No claim is made that these conditions have been "normal" or "natural"; doubtless they have fallen short of being optimal even for our purposes. In so far as considerations of health permitted, however, they have been essentially constant for all individuals. They were designed to promote healthy growth at not too great a cost in time and energy. During the first two years of life the animals are kept in individual cribs and cages. The problem of cleanliness has been solved by use of disposable diapers. Feedings are on a regular schedule decreasing in number from six at birth to four per day at age of thirteen weeks. The bottle formula is increased in strength, and new items of diet are added, at stated intervals. Except for special occasions, human contacts have been limited to four individuals: a female colored nurse, a white male assistant, Dr. Austin H. Riesen and the writer.

The schedule of tests, measurements and other records which have been made routinely, and with few exceptions[2] at the intervals indicated, of all members of the group, may be outlined as follows:

1. Body weight (daily at 10 A.M.).
2. Eruption of teeth (checked daily).
3. Fifty anthropometric measurements (monthly during first year of life, quarterly thereafter).
4. Physical description record of coat and skin characteristics (semi-annually during the first year, annually thereafter).
5. Photographic portraits in a standardized situation (monthly during the first year, bimonthly thereafter).
6. Radiographs (some parts monthly, others bimonthly, quarterly, semi-annually).
7. Food intake (each feeding).
8. Axillary temperature (three times weekly).
9. Pulse rate (three times weekly).

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[2] The x-ray studies were not begun until fall, 1940.

10. Respiration rate (three times weekly).

11. Galvanic skin resistance (irregularly, under various conditions).

12. Activity records (usually continuous for 2 days or longer, at different ages).

13. Behavior tests—Gesell schedule with certain omissions and additions adapted to typically chimpanzee behavior (biweekly to the eighth week, every four weeks during the remainder of the first year, quarterly thereafter).

14. Records of behavior appearing in the nursery environment: locomotion of all kinds, vocalization, feeding habits, grooming activity, ticklishness, emotional expression, response to human contacts, tics and so on.

These "normative" data doubtless will have certain intrinsic interest and may be of value to various special branches of biological science. Our use of the results will be fourfold: (1) The data will provide base lines from which the effects of experimentally introduced variables can be measured. (2) They will be examined for intercorrelations of such "naturally" produced variations as weight and food-intake, health and bone "scars," behavioral and somatic development, parent and offspring characteristics, and so on. (3) The developmental trends manifested by the data will be compared to those of other species, particularly those of the human infant, and to the known characteristics of the adult chimpanzee. (4) Most importantly, perhaps, these results will raise questions for experimental investigation and will indicate the feasibility and significance of various lines of attack.

Since the program was initiated in July, 1939, there have been fourteen births at the laboratories, seven males and seven females. The infants were separated from their mothers soon (median, 17 hours) after parturition and were at once placed under the care of human attendants in the nursery. One male was returned to his mother 48 hours later, after the first series of tests, measurements and descriptions had been made; this animal will be the first of several "controls" who will serve to indicate the effects of our nursery environment as compared to the care given by the captive chimpanzee mother. One female was transferred to another laboratory at the age of two months. Another female died at the age of seven months; it seems highly probable that some innate weakness was primarily responsible for her death. The remaining eleven animals, the oldest ones now over two years old, are thriving in the nursery situation. The program is to include the first three years of life. The present members of the nursery will serve primarily as the "normative group," and with them the standard list of tests and measurements will be continued until they reach that age. Infants born hereafter are to be used experimentally, in accordance with the view-point and orientation presented above.

OBITUARY

HEBER D. CURTIS

THE scientific career of Heber D. Curtis began at a time when the old-line astronomy of position was being supplemented by the "new astronomy." His first important papers dealt with latitude work, eros observations, comet orbits; many of the papers after his ninth deal with astronomical spectroscopy. Dr. Curtis brought a broad and thorough training in fundamental astronomy to bear on the problems of the newer field, and the "new astronomy" has benefitted greatly, directly and indirectly, through his work and his counsel. His observations of stellar spectra extend over a decade and were accompanied by measurement and discussion, the system of Castor being one of the many interesting papers which he published in these years.

His work on comets was continued for several years, and the remarkable series of photographs of Halley's Comet secured by Curtis has yielded important results in the hands of himself and others.

The work which he himself rated most highly, and which has perhaps been of greatest usefulness, is the observation of nebulae. Curtis finished the survey begun by Keeler and discussed the results of the program in the Lick Observatory Publications. His general treatise on nebulae was published in the Handbuch der Astrophysik. This is an important document for any one who is interested in nebulae from any point of view.

From the beginning to near the end of his scientific activity, Curtis observed solar eclipses, taking part in the observation of eleven. In this work his mechanical genius and resourcefulness had room for full play. The discovery of the strong coronal lines in the infra-red is one of the important results of these many eclipses which has been ascribed to Curtis. Also any success which his party may have had was certainly due in part to his presence. The travel, visiting new places and meeting people of every race and culture were features of esclipse expeditions which he enjoyed and exploited to the full.

Heber D. Curtis was born on June 27, 1872, at Muskegon, Mich. At the University of Michigan he was granted the degrees of A.B. and A.M. in the years 1892 and 1893. The University of Virginia granted him the Ph.D. degree in 1902; and from the

University of Pittsburgh he received the honorary degree Sc.D. in 1930. He was a member of the Astronomical Society of the Pacific (President, 1912); American Association for the Advancement of Science (vice-president, Section D, Astronomy, 1924); American Astronomical Society (vice-president, 1926); Astronomische Gesellschaft; National Academy of Sciences; American Philosophical Society; Research Club (University of Michigan); foreign associate, Royal Astronomical Society; International Union; member of Commission 13 of solar eclipses; Phi Beta Kappa; Sigma Xi; Phi Kappa Phi.

He taught Greek and Latin at Napa College from 1894 to 1896, and was professor of mathematics and astronomy at the College of the Pacific from 1896 to 1900. As a teacher and public lecturer he was unexcelled. He had the faculty of presenting astronomy to the beginner or to the layman in such a way as to display the facts and instil the spirit of the science. After two years as Vanderbilt fellow at the University of Virginia he joined the staff of the Lick Observatory in 1902, rising to the rank of astronomer in 1911, a position which he left to become director of the Allegheny Observatory in 1920. His stay at Lick was interrupted in 1906 when he went to Santiago, Chile, in charge of the Lick Southern Observatory, from which station he returned in 1910 to take charge of the Crossley Reflector. His engineering ability was used here in providing convenient controls and working conditions for this erstwhile troublesome instrument. In 1917 he joined the optics section of the National Bureau of Standards, and worked at the design of military instruments, returning to Lick when hostilities ceased.

Beginning in 1920, Curtis spent a happy decade at the Allegheny Observatory. Here, besides doing his share of observing, he designed and constructed several instruments whose use has simplified and improved observation. He took great enjoyment in this work, at which he was unusually skilful. In fact, the planning and building of new instruments for eclipse work was perhaps the most enjoyable feature of the five expeditions which he accompanied or led in the Allegheny decade. Wherever he was located, Curtis always found opportunity to improve the equipment, often by his own handiwork.

In 1930 Michigan sought a man to design a new telescope and called Curtis to the directorate of the University Observatory. The proposed large reflector did not materialize, but a development of far greater promise grew under his guidance in this last decade. And this was possible because Curtis not only knew science and mechanics, but understood men and was able properly to estimate their potentialities and direct their abilities. The solar work of the McMath-Hulbert Observatory is in a very true sense a monument to such understanding and encouragement. His friendly disposition and constant desire to be helpful not only accomplished much for science but made him beloved by all his associates.

The few philosophical papers presented by Curtis have a value which is large in comparison with the number of pages written. Curtis published about 120 papers dealing with scientific subjects and 20 of a more general nature. Many of these are of prime importance, but they imply, rather than record, his value to science, which resided rather in his helpfulness to his associates through counsel and encouragement.

The passing on January 9, 1942, of this scientist, teacher and counsellor created an unusual feeling of loss and sorrow. Dr. Curtis is survived by his wife, Mary D. Curtis; by a daughter, Mrs. A. J. Walters; by three sons, Rowen D., Alan B. and Baldwin R.; and by five grandsons. To these the world of science expresses deep sympathy.

KEIVIN BURNS

DEATHS AND MEMORIALS

DR. SOMA WEISS, Hersey professor of the theory and practice of physic at Harvard Medical School and physician in charge of the Peter Bent Brigham Hospital, died on January 31, at the age of forty-three years.

BION J. ARNOLD, consulting engineer, died on January 29, at the age of eighty years. Mr. Arnold had been a mechanical engineer for the Chicago and Great Western Railway, a consulting engineer for the General Electric Company and an advisory traction engineer for the cities of Pittsburgh, Toronto, Chicago, Providence, Los Angeles, Cincinnati and San Francisco.

DR. FRANK SMITH, professor emeritus of zoology at the University of Illinois, died on February 3, at the age of eighty-five years.

CLIFFORD C. GLOVER, professor of pharmacognosy of the College of Pharmacy of the University of Michigan, died on January 31, at the age of fifty-four years.

DR. MARTHA BREWER LYON, member of the Association for Research in Ophthalmology, South Bend, Indiana, died on January 18, at the age of seventy years.

CAPTAIN THOMAS ATHOL JOYCE, formerly deputy keeper in charge of the Sub-Department of Ethnography, department of oriental antiquities and ethnography, in the British Museum, and president of the Anthropological Institute from 1931 to 1933, died on January 3, at the age of sixty-four years.

THE Gray Herbarium of Harvard University is completing, through a special gift, an addition to its building to be called the Benjamin L. Robinson Wing in memory of Professor Robinson, formerly curator of the herbarium. The plans for the equipment of this wing contemplate an additional expenditure of $35,000. Professor Robinson died on July 27, 1935.

As a memorial to Professor E. P. Kohler, professor of chemistry at Bryn Mawr College until 1912 and, at the time of his death in May, 1938, Sheldon Emery professor of organic chemistry at Harvard University, a fellowship for graduate study in chemistry has been endowed through contributions of his students and friends. The announcement says: "The special purpose of the fellowship is to perpetuate the memory of a man distinguished by his eminence as a scientific man and beloved as a teacher of rare qualities who exerted a profound and wide-spread influence on the progress of instruction in chemistry throughout the country."

A MEMORIAL service for Professor Frances Gertrude Wick, chairman of the department of physics and a member for thirty years of the faculty of Vassar College, was held in the college chapel on January 21. Professor Louise S. McDowell, chairman of the department of physics at Wellesley College, gave the principal address. Dr. Henry Noble MacCracken, president of the college, spoke on behalf of the faculty, and Louise Grosvenor, of New York, a junior majoring in physics, on behalf of the students.

SCIENTIFIC EVENTS

THE FIFTH GENERAL HOSPITAL (HARVARD UNIVERSITY UNIT), U. S. ARMY[1]

AT 9:00 A.M. on January 10 the U. S. Army Fifth General Hospital (Harvard University Unit), the successor to Base Hospital No. 5 of 1917–19, left Boston for an eastern seaboard camp as the first step to active duty in this war. This represents a further contribution of Harvard University to National Defense. Harvard University has already established in England an American Red Cross-Harvard Hospital, directed by Dr. John E. Gordon, professor of preventive medicine and epidemiology, which for some months has been actively engaged in aiding the British in the care and study of communicable diseases.

The former Base Hospital No. 5 was presided over by the late Dr. Harvey Cushing and had an enviable record. Many of its officers rose to positions of importance in the Army. The hospital suffered the first American casualties, when it was bombed the night of September 5, 1917.

Now after a twenty-year interval a new group undertakes a similar effort. For historical purposes the following should be recorded. On November 16, 1939, the Surgeon General of the United States Army wrote Dean Burwell of the Medical School that shortly he would approach the Medical School with an official request that it organize a regular Army inactive unit, General Hospital No. 5, "thus perpetuating the fine traditions of United States Army Base Hospital No. 5." Similar units were proposed for all medical schools and hospitals which had served in a like capacity in the War of 1914–1918. These units were to have a normal bed capacity of 1,000 and a personnel which would include 42 officers, 120 nurses and 400 enlisted men. Subsequently the number of officers was raised to 73, including the administrative service.

The office of Unit Director was assigned to the author, and immediately steps were taken to secure the officer personnel, which according to instructions should be limited to members of the parent institution. Members of the teaching force of the Medical School, whether working in the laboratories of the school or attached to one of the affiliated hospitals, were eligible. The heads of all departments in the school were consulted as to what men in their department either cared to join or, in the opinion of the head of the department, should not join because of essential duties here. A definite attempt was made to spread the personnel as widely as possible. Because of the ramifications of the university, we were able to call upon individuals from all the major Boston hospitals as well as from the Hygiene Department in Cambridge. Thomas H. Lanman, '12, M.D., '16, assistant professor of surgery, and Theodore L. Badger, M.D., '26, instructor in medicine, were early selected as the respective chiefs of the Surgical and Medical Divisions. Their continued labors and unflagging interest have greatly facilitated the formation of the present unit.

On December 24, 1941, a telephone call from the Surgeon General's office warned the unit that it would have only a few days to prepare for active duty. Immediately final physical examinations, the purchase of equipment and the addition of the nurses and the new officers were undertaken. The necessary prophylactic inoculations were started. Boston stores were called on to supply uniforms, the style, quality and types of these being added to each day. A hurried trip to Washington by the acting director expedited these matters.

Generous friends donated money for a Fifth General Hospital Fund, similar to that possessed by the hospital in the last war. With these funds assistance has already been given in many ways to officers and to the nurses. The Boston Metropolitan Chapter of the American Red Cross donated sleeping bags to all nurses going with the unit.

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[1] Reprinted by special permission of the *Harvard Medical Alumni Bulletin*, January, 1942, issue.

At 5:00 P.M. on January 9, members of the former Base Hospital No. 5 who had formed themselves into Harvard Base "5" Club presented colors to their successor unit, the new Fifth General Hospital, which has now gone on active duty. The colors were presented by Dr. Lewis M. Hurxthal, of the former unit, to Lt. Col. Theodore L. Badger, chief of the Medical Service of the new unit. The ceremony was attended by the following members of Base Hospital No. 5 of 1917–1919 and many friends: Walter J. Irving, William F. Whitley, Montgomery C. Reed, Kenneth J. Crowell, Joseph J. Wilson, Dr. Lewis M. Hurxthal, Harold J. Davidson and Dr. Elliott C. Cutler.

Dr. Hurxthal's speech of presentation follows: "Twenty-five years ago, United States Army Base Hospital No. 5 of World War I was organized. The unit embarked in May, 1917, and took over active hospital work in June, 1917, in France. Under the direction of Colonel Robert U. Patterson and Colonel Harvey Cushing, Base Hospital No. 5 performed an outstanding service to the wounded and sick in France and contributed much to military medicine. Two of the outstanding contributions were in the field of brain surgery and in the introduction of blood-grouping to the British Army. Many lives were saved because of these contributions.

"The members of former Base Hospital No. 5, officers, nurses, and enlisted men, are proud of their war record of two years service in France. They are also proud that a new unit will carry on under the same name, and are confident that it will return with the same enviable record as its predecessor.

"Harvard Base '5' Club is an organization founded in 1929 by former members of the United States Base Hospital No. 5. In behalf of all the members of the unit, Harvard Base '5' Club wishes to contribute a connecting link between the old and the new. The two groups have many things in common: both were organized in Boston; both were composed of volunteers; and both were called to duty within a few weeks after the declaration of war. We have, therefore, chosen as a bond of continuity the American Flag. We hope this particular flag will serve as the official colors of the new organization as well as an inspiration for a meritorious performance of duty. We wish you success and bon voyage."

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The orders for the unit activated forty-seven officers, leaving eleven behind whose papers had not yet been completed to wait for subsequent orders to join the unit. These orders came shortly, and one week later, on January 17, the second group left Boston to join the main body of the unit.

Forty-four nurses left with the unit representing the following hospitals: Arlington Training School, Beth Israel Hospital, Children's Hospital, Homeopathic Hospital of Rhode Island, Massachusetts General Hospital, McLean Hospital, New England Baptist Hospital, New England Deaconess Hospital, Peter Bent Brigham Hospital, Robert Breck Brigham Hospital and Sturdy Memorial Hospital.

At the last minute the acting director was refused permission by the Surgeon General to leave with the unit because of the urgent request of the university that his duties were essential for the moment here.

We who remain behind must look with pride and gratitude on these men and women who have now accepted the call to serve their country. We know of their great abilities and feel sure that they will fulfill adequately the high traditions of their predecessors and will play a major role in the United States Army Medical Corps from now until they return to us. To their families we extend our congratulations and our devotion. The university will long cherish this effort on the part of its graduates.

ELLIOTT C. CUTLER, M.D.

THE NEW NATIONAL ASTROPHYSICAL OBSERVATORY OF MEXICO

MANY astronomers, physicists and geologists, from both North and South America, will participate in the Inter-American Scientific Conference in Mexico, which meets from February 15 to 26, on the occasion of the dedication of the new National Astrophysical Observatory.

President Manuel Avila Camacho, of Mexico, in his invitation said: "The purpose of the Mexican Government is to contribute to the maintenance, in the American continent, of the progress of science and culture, and thus counteract as much as possible the paralyzation of scientific and cultural activities in the countries devastated by war."

On the provisional program for the conference are the names of many of the leading astronomers of the United States, including Dr. Walter S. Adams, director of Mt. Wilson Observatory; Dr. Henry Norris Russell, director of Princeton Observatory; Dr. Harlow Shapley, director of the Harvard College Observatory; Dr. V. M. Slipher, director of the Lowell Observatory; Dr. Joel Stebbins, president of the American Astronomical Society, and Dr. Otto Struve, director of the Yerkes and McDonald Observatories.

Argentina will be represented at the conference by the director of the National Observatory at Cordoba, Dr. Enrique Gaviola, who will preside at one of the sessions, while from Canada will come Dr. Joseph A. Pearce, director of the Dominion Astrophysical Observatory, Victoria, British Columbia. Leading Mexicans participating in the conference are: Professor Luis Enrique Erro, director, and Dr. Carlos Graef, assistant director, of the new National Observatory; Dr. Monges-Lopez, dean of the faculty of sciences of the National University of Mexico; Professor Manuel S. Vallarta, of the Massachusetts Institute of Technology; Dr. Joaquín Gallo, director of the National Observatory at Tacubaya, and Dr. Alfredo Banos, Jr., head of the department of physics of the National University.

Nearly the entire field of modern astronomy and geophysics will be covered by the papers to be presented at the various conference sessions, the subjects of which are: The interstellar medium, the classification of stellar spectra, problems of the galaxy, variable stars, time and change, cosmic radiation and geophysical problems. In addition, there will be special evening lectures on related topics, as follows:

The Surfaces of the Major Planets: Dr. Slipher.
The Cosmogonical Significance of Stellar Rotation: Dr. Struve.
The Present State of the Theory of Stellar Evolution: Dr. Russell.
Time and Change in the Metagalaxy: Dr. Shapley.

Most of the sessions and lectures will be held at Puebla, including the dedicatory exercises on the morning of February 17. Dedicatory addresses will be given by President Camacho and the Governor of Puebla. For special academic ceremonies an excursion will be made to Morelia on February 23 and 24, with the final sessions being held in Mexico City.

The new National Astrophysical Observatory is situated on land provided by the government of the State of Puebla, near a small town of Aztec origin called Tonanzintla, about eighty miles east of Mexico City. Under the direction of Sr. Erro, observations of the southern Milky Way will be made with a 24-30-inch Schmidt camera, the most powerful telescope in the tropics. This instrument is similar to the Jewett telescope at Harvard Observatory, and was mounted in the Harvard shops. Its location in latitude 19° is strategic for studies of the southern parts of the sky, inaccessible to instruments farther north. The climate is excellent for observations, especially during the winter, and the program of the observatory also calls for variable-star studies and observations of meteors and the sun.

THE SUMMER SESSION OF NEW YORK MEDICAL SCHOOLS

IN response to the present need for the training of a large number of men in medicine to take the places of those called into service, an accelerated program for the course has been announced by the five medical colleges in New York City.

At the Columbia College of Physicians and Surgeons, the Cornell University Medical College, the Long Island College of Medicine, the New York Medical College and the New York University College of Medicine, plans have been formulated to conduct regular work for all classes during the coming summer and to open the next regular session early in July. The new schedules adopted in these institutions will make it possible for the student to cover the full medical course within the space of thirty-six months instead of, as at present, distributed over forty-eight months.

Under the accelerated plan as announced, however, there is to be no reduction in the amount of time the student devotes to his medical training and, likewise, there will be no relaxation in the standards of teaching in the medical course. Instead of the summer vacation of approximately three months, the students under the new plan carry on regular work in the classrooms, laboratories and hospital wards, thereby shortening the time of the medical course by one year. Although the course is practically continuous, throughout the year, short vacations will be given between each of the four terms.

The five New York City medical colleges would normally graduate under the present plan approximately 1,350 physicians in a three-year period. Under the accelerated schedule it would be possible, if continued, for these schools to graduate 1,800 in the same period, or approximately 450 additional doctors to enter internships in the hospitals. Since the Army and Navy are calling many young physicians from the hospital staffs, this increase in the number of medical graduates may mean much in the care of the sick and in supplying the needs of the military services.

AWARDS FOR ACHIEVEMENT IN AERONAUTICS

THE tenth annual meeting of the Institute of Aeronautical Sciences was held in New York City during the week of January 26. *The New York Times* reports that the annual dinner presentation was made of six awards for achievements in aeronautics.

Juan Terry Trippe, president of Pan American Airways, received the Daniel Guggenheim Medal, awarded annually since 1926, for his achievement in the development and operation of oceanic air transport. The presentation was made by Brigadier General Donald H. Connolly, national director of civil aviation of the Army Air Force.

The Sylvanus Albert Reed Award went to Theodor von Kármán, director since 1930 of the Daniel Guggenheim Graduate School of Aeronautics at the California Institute of Technology, for "the development of a satisfactory theory of the influence of curvature on the buckling characteristics of aircraft structures." The presentation was made by Dr. J. C. Hunsaker, chairman of the National Advisory Committee for Aeronautics.

Melvin Nielson Gough, senior test pilot at the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics, was given the Octave Chanute Award for "outstanding contributions to fundamental research in aeronautics as conducted in airplanes in actual flight." He received the award from Lieutenant Colonel James H. Doolittle, director of operational requirements, headquarters staff, Army Air Force.

The Lawrence Sperry Award, as already reported in SCIENCE, went to Ernest Gordon Stout, engineer in charge of air dynamics for the Consolidated Aircraft Corporation, for his contributions "to the experimental determination of hydrodynamic stability of model flying boats and sea planes." The presentation was made by Charles H. Colvin, of the Daniel Guggenheim Graduate School of Aeronautics.

Major Harry George Armstrong, of the U. S. Army Medical Corps, received the John Jeffries Award for "basic studies on the physiological and psychological effects of flight at high altitudes and the description of a number of clinical entities involved, the establishment of the Army Aero Medical Research Laboratory and contributions to the literature of aviation and medicine." The presentation was made by Dr. Louis H. Bauer, editor of *The Journal of Aviation Medicine.*

The Robert M. Losey Award was presented to Dr. Horace Robert Byers, meteorologist of the United States Weather Bureau, for "research in air mass analysis and its application in synoptic and aeronautical meteorology." The presentation was made by Dr. F. W. Reichelderfer, chief of the United States Weather Bureau.

Frank W. Caldwell, director of research at the United Aircraft Corporation and president of the institute, presided over the ceremonies.

ADVISORY COMMITTEE ON SCIENTIFIC PUBLICATIONS

MANY investigators who are planning to submit manuscripts or abstracts for publication will undoubtedly have occasion during the war emergency to query whether the publication might not inadvertently become of assistance to our enemies. Since it may be impossible for the author to answer the question from his own personal knowledge, the National Academy of Sciences and the National Research Council have organized an Advisory Committee on Scientific Publications to deal with the matter. This committee is ready to advise editors of journals and secretaries of societies concerning the procedure to follow when manuscripts or abstracts that might fall into this category are submitted for publication or question is raised concerning an investigation in progress. If it is decided that postponement of publication is advisable, the author and editor are so informed. When postponement of publication is no longer necessary, and the manuscript or abstract is published, there will be an accompanying note indicating the date on which the paper was received for publication and that the paper was withheld because of its bearing on the war emergency. Although this will mean delay in publication for a time in some cases, in others it will facilitate the publication of results which otherwise might be withheld owing to the author's uncertainty as to the possible military significance of his work.

FRANK B. JEWETT,
President, National Academy of Sciences
ROSS G. HARRISON,
Chairman, National Research Council
LUTHER P. EISENHART,
Chairman, Advisory Committee on Scientific Publications

SCIENTIFIC NOTES AND NEWS

THE Society of Economic Geologists, on the recommendation of a committee consisting of B. S. Butler, T. S. Lovering and Adolph Knopf, chairman, has awarded its Penrose Medal to Professor William H. Emmons, of the University of Minnesota, in recognition of his outstanding contributions to the science of economic geology. The presentation was made on February 10, at the annual dinner of the society in New York.

JOSEPH J. GEORGE, chief meteorologist of the Eastern Air Lines, has been presented with the Meisinger Award of the American Meteorological Society for the "most outstanding work in the aerological field during the year." The award was based upon Mr. George's work in fog prediction and the effect of lakes on air distortion. Presentation of the award was made at the recent annual business meeting of the society held at Columbia University.

PROFESSOR JOHANNA WESTERDIJK, director of the Phytopathological Institute and the Central Bureau for Fungus Cultures in Baarn, the Netherlands, celebrated the twenty-fifth anniversary of her appointment to the first professorship in plant pathology at a Netherlands university on February 10. A congratulatory telegram has been sent to her by her American colleagues, from South America. The collections of the Central Bureau and of her laboratory have not been damaged in any way by the war, and all work is being continued by the complete staff, as in former years.

THE University of San Marcos, Peru, has awarded the degree of doctor *honoris causa* to Dr. William

Seaman Bainbridge, of New York City, in recognition of his work on cancer and his contributions to medical progress in Latin America.

DR. FRANK S. HOGG, assistant professor of astronomy at the University of Toronto and a member of the staff of the David Dunlap Observatory at Richmond Hill, Ont., was re-elected president of the Royal Astronomical Society of Canada at the recent annual meeting. Other officers elected were: *Vice-presidents*, Dr. A. Vibert Douglas, dean of women, Queen's University, and Dr. A. E. Johns, of McMaster University; *General Secretary*, E. J. A. Kennedy; *General Treasurer*, J. H. Horning; *Recorder*, H. W. Barker; *Librarian*, Dr. P. M. Millman; *Curator*, R. S. Duncan, all of Toronto.

AT the annual business meeting of the Ecological Society of America, held in Dallas, Texas, on December 31, the following officers were elected: *President*, 1942, C. F. Korstian (botany), Duke University; *Vice-president*, 1942, C. E. ZoBell (zoology), Scripps Institution; *Secretary*, 1942–44, William A. Dreyer (zoology), University of Cincinnati; *Representative on the National Research Council*, 1942, Ira N. Gabrielson (conservation), U. S. Biological Survey; *Representative on the Council of the Union of American Biological Societies*, 1942, A. M. Banta (biology), Brown University. Dr. Royal E. Shanks (botany), State Teachers College, Clarksville, Tenn., continues in office as treasurer of the society. The work of two of the committees essential to the program of the society was approved and it was voted to continue their activities. They are: Committee on the Preservation of Natural Conditions, *chairman*, Curtis L. Newcombe (biology), College of William and Mary; Committee for the Study of Plant and Animal Communities, *chairman*, S. Charles Kendeigh (zoology), University of Illinois.

DR. J. A. W. HETRICK, professor of otolaryngology and director of the department, and since 1924 assistant and associate dean, has been appointed dean of the New York Medical College Flower and Fifth Avenue Hospitals. He has been serving as acting dean since March, 1941, following the death of Dr. Claude A. Burrett.

DR. JOHN H. MUSSER, professor of medicine at the School of Medicine of Tulane University of Louisiana, has resigned as president of the State Board of Health, in order to devote all his time to work at the School of Medicine.

DR. JOHN W. BARNARD, assistant professor of anatomy at the Georgetown Medical School, has been appointed professor and head of the department of anatomy at the new School of Medicine of Oglethorpe University.

ALLYN R. JENNINGS, since July, 1940, general director of the New York Zoological Park, has left to become associated with the Pan American Airways system in an engineering capacity. Mr. Jennings, before becoming director of the park, was superintendent of parks in New York City under Park Commissioner Robert Moses.

DR. MAURICE HOLLAND, formerly director of the Division of Engineering and Industrial Research of the National Research Council, has been appointed industrial research adviser to the New York University College of Engineering. Charles H. Colvin, director of the Guggenheim School of Aeronautics at the college, has been made coordinator of research, to work with Dr. Holland. Mr. Colvin founded and is a former president of the Pioneer Instrument Company. Before going to New York University he was chief of the instrument division of the U. S. Weather Bureau in Washington.

A. W. THORSEN, of Detroit, assistant fuel service engineer for the Chesapeake and Ohio Railway Company for the last two years, has been appointed a member of the staff of the Coal Research Laboratory at Carnegie Institute of Technology. He assumed his new work on February 1. Mr. Thorsen will assist the president in securing financial support for the laboratory and will also assist Dr. H. H. Lowry, director of the laboratory, with its general business operations.

A SUBCOMMITTEE on anthropology for Latin America has been appointed by the National Research Council, consisting of Dr. A. L. Kroeber, professor of anthropology, University of California; Dr. F. W. Hodge, of the Southwest Museum, Los Angeles, and Dr. Donald Brand, of the University of Mexico, to assist in carrying out the plans of the State Department for furthering research and anthropological study in Latin American countries. These plans include an exchange of cultural envoys and a study of ethnic traits.

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, spoke on February 12 at the University of Texas on "Stars over Texas." Dr. Arthur H. Compton, University of Chicago, will speak on February 20. The title of his lecture will be "Physics Looks at the Future."

DR. CONRAD A. ELVEHJEM, professor of biochemistry at the University of Wisconsin, delivered on February 3 the first Mary Swartz Rose memorial lecture at the Academy of Medicine, New York City. He spoke on "Natural Foods in the American Dietary." The lecture was sponsored by the Greater New York Dietetic Association in memory of Dr. Rose, professor of nutrition at Teachers College, Columbia University.

DR. MEL. T. COOK, who retired last year as plant pathologist at the Puerto Rico Agricultural Experiment Station, recently gave a series of lectures on "Virus Diseases of Plants" and on "Science in Latin America" at the Oklahoma Agricultural and Mechanical College.

DR. GEORGE W. CORNER, director of the department of embryology of the Carnegie Institution of Washington, gave at Princeton University, from February 9 to 13, a series of public lectures on the Louis Clark Vanuxem Foundation. His subject was "Ovarian Hormones in Human Reproduction."

DR. KARL K. DARROW, research physicist of the Bell Telephone Laboratories, New York City, addressed on January 22 a joint meeting of the University of Cincinnati Chapter of Sigma Xi and the Cincinnati Section, Student Branch of the American Institute of Electrical Engineers, the Institute of Radio Engineers, the Illuminating Engineering Society and the Engineers' Club of Cincinnati. He spoke on "Physical and Chemical Forces."

AT the Johns Hopkins University, the twenty-third course of Herter lectures was given on February 3, 4 and 6 by Dr. Edgar Douglas Adrian, professor of physiology at the University of Cambridge. The general subject of the lectures was "The Organization of the Senses."

THE Civil Service Commission, recruiting for the Federal Civil Service, is accepting applications for all grades and branches of engineering. Some of the engineering examinations have been recently consolidated and modified. None requires a written test. For the junior grades, $2,000 a year, applicants are rated on their engineering education; no experience is required. In the upper grades, applicants are rated on education, experience and record of accomplishments. In all but the examination for chemical engineer, professional engineering experience may be substituted for the college work. Salaries for chemical engineer are $2,600 to $5,600. There is a shortage of engineers experienced in specialized branches of plant layout, equipment design, market analysis, chemical economics, heavy chemicals, plastics, rubber, agricultural by-products and strategic minerals. Naval architect, marine engineer, $2,600 to $5,600 a year. Engineer (all other branches), $2,600 to $5,600 a year. For all upper grades the age limit is sixty years except that for the three highest grades of marine engineering and naval architecture—$3,800 to $5,600 a year—the age limit is seventy years. There are also opportunities in the sub-professional and lower grades. Applications for all these positions are being accepted for several months or until further notice. Full information can be obtained from the U. S. Civil Service Commission, Washington, D. C., or from any first- or second-class post office.

THE National Research Fellowship Board in the Natural Sciences has extended the time for receiving applications for fellowships until February 23. Application forms and announcements stating conditions of award will be sent on request, which should be addressed to the Board at the National Research Council, 2101 Constitution Avenue, Washington, D. C.

APPLICATIONS to the Committee for Research in Problems of Sex, National Research Council, for financial aid during the fiscal year beginning July 1, in support of work on fundamental problems of sex and reproduction, should be received before April 1. They may be addressed to the chairman, Dr. Robert M. Yerkes, Yale School of Medicine, New Haven, Conn. Although hormonal investigations continue to command the interest and support of the committee, preference, in accordance with current policy, will ordinarily be given to proposals for the investigation of neurological, psychobiological and behavioral problems of sex and reproduction.

A NEW organization for botanists of the Chicago area was recently formed at the Chicago Academy of Sciences. The group has selected for its name the Cowles Botanical Society, honoring the late Dr. Henry C. Cowles, a distinguished botanist of the Chicago area. Meetings are held in the Academy of Sciences at 8:00 P.M. on the third Tuesday of each month. The objectives of the society are to promote better contacts between persons interested in botany, to collaborate in the attack on various botanical problems, and to provide renewed inspiration and stimulation in botanical studies. All interested in botany are cordially invited to attend the meetings. Dr. Max Britton, of the department of botany at Northwestern University, was the speaker at the January meeting. He spoke on "Observations on the Hemlock-White Pine-Northern Hardwood Forest of Pennsylvania." The February meeting will be held on Tuesday evening, February 17. Dr. Charles A. Shull, of the department of botany at the University of Chicago, will speak on "New Developments in Plant Physiology."

DEDICATION of the Hooker Scientific Library to American scientists was announced by the "Friends of the Hooker Scientific Library" in the January issue of their official organ, *Record of Chemical Progress.* The dedication is in fulfilment of Dr. Hooker's desire, but was not publicly announced until the library was able to establish a comprehensive plan of technical literature services. As another step toward making these services available a revised schedule of corporation and institutional membership fees is announced. The minimum fee for permanent membership, which has been $100 for any corporation or institution, remains at this level for laboratories having ten or more research workers. For smaller laboratories it is based on the size of the research staff. Full information about the library as a nonprofit service institution may be obtained from the Hooker Scientific Library, Central College, Fayette, Mo.

The annual California Audubon Convention was held at Santa Barbara from January 23 to 25. The exhibits included paintings by and objects connected with Audubon, and these were discussed by Donald Culross Peattie, who also spoke on the life of Audubon. There were shown many colored motion picture films and Kodachromes, such as those of Mrs. Laurel Reynolds of California birds, Mr. Hoff's life history of the brown-tailed humming-bird, Mr. Harwell's picture of the Audubon Nature Camp in Maine, Mrs. Hood on the young of the California woodpecker and F. F. Gander on Lower California.

The Council on Dental Education of the American Dental Association has issued a series of recommendations to the dental schools of the United States with reference to an acceleration of their work for the period of war emergency. These recommendations are essentially: That such acceleration be undertaken where it is possible without loss in teaching effectiveness; that there be no reduction in the number of hours devoted to the dental course; that so far as practicable the accelerated program should begin June, 1942. The council plans to gather data from the various schools concerned regarding the additional financial burden on the school and student. This information will be used to make known to university officials and Federal agencies the financial needs of dental education.

Provisional commissions as ensigns will be granted by the Navy, on application by students, to young men taking pre-medical college work who have been accepted for the next entering classes in Class A medical schools. After completing medical courses and serving internships of one year each, they will be commissioned as lieutenants, junior grade, and called to active duty. The granting of provisional commissions will serve to prevent the drafting of such students.

DISCUSSION

INSECTS AS CARRIERS OF POLIOMYELITIS VIRUS

In Science for December 19, 1941, A. B. Sabin and Robert Ward report the recovery of the virus of poliomyelitis from the bodies of certain flies. Their account leaves no doubt as to the presence of active virus as shown by its infectivity for Cynomolgus monkeys when the latter received simultaneous doses of the insect material through several portals (intraperitoneally, intranasally and by mouth). As they cite several other similar recoveries besides those recently reported by Paul *et al.*[1] it is clear that the virus of poliomyelitis may be acquired under natural conditions by certain flies and may temporarily retain its virulence on or within their bodies. Where the flies may have obtained it must remain conjectural, but it is reasonable to suppose that it may have come directly from human alimentary dejecta or secondarily from sewage, since the active virus is well known to be recoverable from these media. It has, of course, long been known that houseflies (*Musca domestica*) fed on suspensions of spinal cord may retain the virus on the body or within the alimentary tract in an active condition for a limited time.

If, as seems highly probable, poliomyelitis is spread in some way through the agency of insects, it is very important to know what species are involved in all experimental studies. Sabin and Ward refer in one case to "flies—mostly large green ones and many house flies" and at another place describe a sample used to infect a monkey as containing small houseflies, green flies, large black flies, a moth, a caterpillar and a four-winged insect. Considering the great diversity of insects and the high specificity that exists between certain insect-borne diseases and particular insect vectors, such identifications are naïvely vague for an otherwise carefully executed experiment. One may guess that the large green flies were probably a species of Lucilia which commonly visits feces or garbage but does not ordinarily contaminate human foods. The houseflies were probably correctly identified, as this is our commonest domiciliary species. The "small houseflies" may have been the same, or possibly the more diminutive *Fannia canicularis*, often numerous in houses, but having very different habits. The large black flies are still more indefinite. They were hardly the large blood-sucking *Tabanus atratus* and most likely refer to some species of Cynomyia or a related genus. The materials with which traps are baited determines to a great extent what species may be caught, and blood-sucking flies are attracted almost exclusively only to living animals. The caterpillar was no doubt innocuous; some species are a favored delicacy not only for monkeys but for human aborigines in many parts of the world. Altogether, in these studies, it is clear that the suspected culprit (if specific) has escaped identification by mingling with a motley crowd of other insects.

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[1] J. R. Paul, F. D. Trask, M. B. Bishop, J. L. Melnik and A. E. Casey, Science, 94: 395, 1941.

There are numerous facts relating to the epidemiology of poliomyelitis that are readily compatible with the belief that insects are at least a major factor in its spread. Many of these are utterly at variance with the assumption so long current that it is spread by healthy human carriers, although they have commonly been disregarded by the proponents of this view.

During the early epidemics of poliomyelitis in Massachusetts and later at the time of the great outbreak in New York City in midsummer, 1916, the writer attempted to correlate the epidemiology of this disease with reference to some possible insect vector.[2,3,4] There are wide differences among the several insects known to be vectors of disease, with reference to distribution, seasonal prevalence and association with the artifacts and ecological changes introduced by civilized life in varied types of human communities. On account of the immutable instinctive behavior of insects in general and our extensive knowledge relating to special groups like mosquitoes, biting flies, fleas, lice, *et al.*, it is by no means idle speculation to apply the deductive method in considering their possible relationship to the epidemiology of a disease like poliomyelitis. Experimental research in several other directions has so far developed no clear picture either of the manner in which poliomyelitis is spread during epidemics, or of how sporadic cases arise. Exact geographical, ecological and seasonal prevalence, relation to lanes of human and animal movement, barriers to insect and animal migration, breeding places, food preferences and the like are differential characteristics of particular insects and as such they are highly significant in this connection.

Preliminary studies, conducted in Massachusetts during 1911 and 1912, indicated a possibility that the biting stable-fly (*Stomoxys calcitrans*) might serve as an insect vector. Corroboratory work by Rosenau and Brues[5] in transmitting the disease in rhesus monkeys by the bites of this fly were promptly confirmed by Anderson and Frost.[6] However, these results could not be repeated by the same workers, nor by others who later made the attempt, and it was obvious that some factor had been overlooked in the first trials; perhaps epizoic parasites like fleas may have escaped attention.

In 1916 a considerable amount of circumstantial evidence was brought to light indicating that poliomyelitis might depend upon dissemination by some insect incapable of free and rapid migration. On this basis it appeared from considerations of seasonal prevalence, distribution in human communities, lines of migration and apparent scattered endemicity, that poliomyelitis is strikingly similar to bubonic plague in its epidemiology. Thus, the pattern of epidemics in relation to population density, their spread with little reference to human travel or activities and the paucity of multiple cases in families, are all prominent features of both poliomyelitis and bubonic plague. The latter is, of course, in recent times restricted almost entirely to tropical regions. It was not recognized then that any rodent was susceptible or capable of acting as a reservoir of poliomyelitis, and desultory attempts at that time to demonstrate the virus in trapped rats were unsuccessful. At about the same time, Richardson[7] had pointed out certain peculiarities of the epidemiology of poliomyelitis that led him to suspect some association with rats. The virus can now readily be propagated in certain rodents, following the discovery by Armstrong in 1939 that the cotton rat (*Sigmodon hispidus hispidus*) is susceptible to the experimentally implanted virus.

As it grows increasingly evident that the spread of poliomyelitis can not be traced to direct human contact nor to indirect contact through healthy human carriers, medical investigators have naturally turned their attention to other likely channels of infection, and certain flies are now under suspicion in connection with the belief that the alimentary canal is a common portal of entry for the virus in the several clinical types of poliomyelitis.

Inasmuch as the whole epidemiological picture dovetails very closely with the well-known habits, distribution, channels of migration and other ecological peculiarities of rats and their attendant fleas, a strong suspicion rests upon these animals. Whether it is a reality must await direct experimental evidence.

Since the precautionary measures most generally advocated to restrict the spread of poliomyelitis are based on the assumption of infection through personal contact, it is particularly urgent that the possibility of insect vectors receive discriminating attention and experimentation.

CHARLES T. BRUES

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[2] C. T. Brues and P. A. E. Sheppard, *Jour. Econ. Entom.*, 5: 305–324, 1912.

[3] C. T. Brues, Monograph on Epidemic Poliomyelitis in New York City in 1916, pp. 136–177, 1917.

[4] C. T. Brues, *Scientific Monthly*, 16: 471–478, 1923.

[5] Bull. State Bd. Health, Massachusetts, Vol. 7, p. 1733, 1912.

[6] Public Health Repts., 27: 1733, 1912.

[7] *Boston Med. Surg. Journ.*, 175: 397–400, 1916.

THE FRUIT TESTING COOPERATIVE

THOSE of your readers who are interested in horticultural progress may not be aware that, unless it can expand its membership somewhat, the New York State Fruit Testing Cooperative Association may have to cease its useful work. The Fruit Testing Cooperative was organized some twenty years ago to serve as a bridge between breeders of new fruits and the testers of new fruits. Many varieties, apparently superior under the conditions where they are originated, prove to possess weaknesses when tested elsewhere. Certain members of the staff of the New York State Experiment Station conceived the notion of a cooperative association which would stand ready to test new varieties of fruit under a great variety of conditions, reporting back occasionally on the results of their tests. The resulting association has been self-supporting since its establishment, requiring no subsidy from any source whatsoever. It has served a useful purpose not only to the fruit breeders in exposing the flaws in some of their production, but to horticulture generally in speeding up the dissemination of worthwhile new productions. The cost of membership is nominal, and members buy the productions which they propose to test out at cost. But in order to continue self-supporting the cooperative must maintain the membership of at least 2,000 persons who are genuinely interested, on the one hand, in assisting the fruit breeders, and on the other hand in having access to the best new productions of the breeders for their own use. Persons interested in the work of the association should write to H. L. King, the manager, in care of the New York State Agricultural Experiment Station, Geneva.

PHILIP M. WAGNER

THE EVENING SUN,
BALTIMORE

NICOTINIC ACID

THERE has been much popular objection to the enrichment of bread with nicotinic acid, the vitamin necessary to prevent pellagra, because of confusion with the poisonous alkaloid, nicotine. In view of this objection the Food and Nutrition Board of the National Research Council recommends the acceptance of "Niacin" and "Niacin Amide" as synonyms for nicotinic acid and nicotinic acid amide. The committee which made the recommendation was composed of Drs. C. A. Elvehjem, W. H. Sebrell and Tom D. Spies. The committee also recommends that the terms nicotinic acid and nicotinic acid amide be used in scientific literature and that the new terms be used only where there may be objection from the public.

Elvehjem in 1937 discovered that nicotinic acid was a specific cure for black tongue in dogs. Spies and others quickly extended Elvehjem's results to the cure of pellagra in man. The newly discovered vitamin, however, had been isolated more than 60 years earlier by treating nicotine with fuming nitric acid and named, therefore, nicotinic acid.

People unacquainted with chemistry but well aware of the deadly character of nicotine and of nitric acid taken separately, have not been able to understand how the combination of two poisons could produce a substance necessary to life and hence have opposed its use in food.

It is hoped that the word "Niacin" may be widely adopted and may allay popular misgivings as to the nature and effect of the anti-pellagra vitamin.

ROBERT F. GRIGGS

STOMATES? STIGMATES, STROMATES!

AT the time of the appearance of Meyer and Anderson's "Plant Physiology," I was somewhat disturbed at their use of the word "stomate" for what we used to call "stoma" but hoped that that usage would not become generally established. Listening to the papers at the recent A.A.A.S. meetings, however, it was evident that a number of people are beginning to use that form. A protest would seem to be in order before the word becomes too firmly entrenched.

Words may quite properly be anglicized if the change makes for easier, more general or more intelligent usage. I have no objection to saying "stoma, stomas." Nor is there any serious objection to modifying a Greek or Latin word if it is unwieldy. "Mitosis" is certainly preferable to the more exact form "mitoschizosis." But is there any possible excuse for taking the plural form of a simple, usable word like "stoma," forgetting that it is a plural, and aglicizing it into an unwieldy singular form like "stomate," and then building a new plural on top of it? That has about as much reason to it as saying "an eggs, two eggses." The old form "stoma, stomas" or "stoma, stomata" was simpler, briefer, certainly as easy to remember. Those who say "stomate, stomates" probably would not think of saying "stigmate, stigmates" instead of "stigma, stigmas (or stigmata)" or "stromate, stromates" instead of "stroma, stromas (or stromata)." Yet these have equal justification. If the reason back of this innovation is a phobia against foreign-language words, why not say "pores" or "little mouths" or "openings"?

Whatever the real basis is, a protest seems justified now before too many helpless students are seduced by this new form of technical jargon!

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SCIENTIFIC BOOKS

STATISTICAL REASONING

Elements of Statistical Reasoning. By ALAN E. TRELOAR, Ph.D. xi + 261 pp. New York: John Wiley and Sons. 1939. $3.25.

THIS is a presentation of fundamental principles of statistics, for readers whose mathematical preparation does not extend beyond elementary algebra. It is designed to explain the purpose, meaning and use of the most important measures of central tendency, dispersion, correlation, statistical significance and goodness of fit. Its aim is the thorough elucidation of those ideas which are of primary importance, rather than superficial treatment of a multiplicity of special topics.

Although nearly half of the book is concerned directly or indirectly with the study of errors of random sampling, detailed discussion of "small-sample techniques" is reserved for another volume. The emphasis here is on the conditions under which the various special forms of frequency function are sufficiently approximated by normal distributions. While full value is ascribed to the significance of the more elaborate analysis in the cases for which it is required, there is no concealment of the conviction that a good big sample is better than a good small sample.

While not technically mathematical beyond the level indicated, the book is not intended for readers who are unable or unwilling to do the kind of accurate thinking which mathematics is designed to facilitate. It is of serious interest to the more advanced student as an essay in determining the extent to which language can be made to supplement or replace mathematical formalism in the precise expression of quantitative ideas. Within the bounds set for the project, anything that can not be formulated in terms of elementary algebra has to be put into words. Naturally there are limits to what can be accomplished in this way; on the other hand, any array of formulas requires the illumination of verbal analysis, and this may well precede detailed study of the formulas themselves, even for a student who is prepared to undertake the latter. It is apparent on every page that the author is in the habit of compelling words to say exactly what he wants them to say, not of tolerating any irresponsibility on their part, and they are made to convey abstract ideas with a surprising degree of definiteness. Rarely they are allowed a moment's deliberate relaxation, as in the reservation, "if sex and goodness are independent," in connection with the multiplication of probabilities, or in the remark in the chapter on vital statistics that "those who die cease to be reporters of events to any terrestrial government." There are a few lapses, a few passages less clearly organized than the rest, and a few places where the reader may be led to think that he is expected to understand immediately something which in fact requires extended explanation; but in general the standard of expression is high. Quotable sentences are numerous.

The illustrative examples are carefully selected and thoroughly explained. While they are mostly taken from biological settings, the numerical data and statistical principles involved are so clearly set forth that the reader whose interest is in other fields of application will have no difficulty either in comprehending them or in adapting their essential features to his own work. The diagrams and tables are gratifying to the eye as well as to the understanding.

The typography is generally excellent. A few errors have been noted. The number 54.125883 in the table on page 57 should be 54.135883; and an exponent 2 is missing in the same panel. The minus sign in the square root on page 140 should be plus; the correct formula appears on the next page. The value of P on page 223 should be .24 instead of .30.

This book will repay careful reading even by students of considerably more technical advancement than those for whom it is primarily designed to serve as an introductory text.

DUNHAM JACKSON

ANALYTICAL CHEMISTRY

Chemical Analysis. A Series of Monographs on Analytical Chemistry and its Applications. *Vol. II. Chromatographic Adsorption Analysis.* By HAROLD H. STRAIN. 222 pages; one colored plate; 37 illustrations. New York: Interscience Publishers, Inc. 1942. $3.75.

THIS excellent analytical handbook covers its important field admirably, both qualitatively and quantitatively. Chromatographic adsorption analysis has become an indispensable adjunct for the final separation of mixtures difficult or impossible to resolve by any other method.

Originally introduced by the botanist Tswett, for the separation of plant pigments, it has been eagerly seized upon, particularly by the organic and biological chemists, for the solution of many extremely troublesome problems of purification. Yet the operations involved are relatively simple and the equipment inexpensive.

A most appropriate colored plate constitutes the frontispiece. It depicts the appearance of two adsorption columns; one showing the separation of carotenes, and the other that of the xanthophylls, with their characteristic so-called "chromatograms," or series of colored bands. The illustrations in the text are well chosen and most helpful. As the author states in his preface, the "major emphasis has been placed upon experimental procedure," and the information supplied in this direction is exceptionally full and critically presented. Following the Historical Introduction (9 pp.), are chapters on the Applications of Chromatographic Adsorption Methods (20 pp.), Apparatus and Procedure (18 pp.), Adsorbents (18 pp.), Solvents and Eluants (6 pp.), and Location of Colorless Adsorbed Substances (6 pp.).

As might be expected, chromatography has not found so many applications in the case of Inorganic Compounds (8 pp.). In the field of Organic Compounds (70 pp.), it has rendered the greatest service —simple aliphatic and aromatic substances, homocyclic and heterocyclic compounds, sterols and related compounds, vitamins, hormones, enzymes, co-enzymes, proteins, anthocyanins, pterins, chlorophylls, hemoglobin derivatives, bile pigments, carotenoids, coal-tar dyes and various natural substances. The volume closes with a résumé of the Industrial Uses (8 pp.) to which the method has been put.

An elaborate Table of Contents makes clear the helpful way in which the subject-matter is organized and presented, and this is supplemented by both an Author Index and a Subject Index. By no means the least valuable feature of the work is a Bibliography covering 42 pp.

The book is heartily commended to all chemists interested in this method of analysis.

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SOCIETIES AND MEETINGS

THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

THE annual meeting of the Council of the Union of American Biological Societies was held in Dallas, Texas, on Monday, December 29, at 4:00 in the afternoon.

As in the past the Union has been concerned with a number of items of general interest to biologists throughout the country. One of the primary concerns of the organization has been *Biological Abstracts*. Dr. John E. Flynn, editor-in-chief of this journal, reported to the Union that the Abstracts for Volume 15 showed a 45 per cent. greater number of abstracts than Volume 14. He furthermore pointed out that whereas 1,105 periodicals were being abstracted in March, 1941, 1,550 periodicals were being abstracted in December of that year, a net increase of 445. A special effort has been made to arrange for the abstracting of foreign journals, many of which are now difficult or impossible to procure in this country. The steadily increasing cost of publication of the abstracts was pointed out, but it was explained that since, of course, *Biological Abstracts* was a non-profit organization, all money which has become available has been used as efficiently as possible to maintain and improve the journal. It was assured that when more money would be made available, *Biological Abstracts* would be correspondingly enlarged and improved. It was stated that the *Abstracts* had operated without a continuing deficit in the past, but that this could no longer be done now that all foreign subscriptions except those of South America and the British Empire were most probably lost. Dr. Flynn called the attention of the council, however, to certain encouraging signs, namely, the significant increase in subscriptions by United States and Latin American biologists. Since spring the number of subscriptions of the latter group had increased 100 per cent. or more. Despite the fact that American biologists are becoming increasingly aware that *Biological Abstracts* is their own instrument, this journal still needs much greater support in the form of individual subscriptions before it can become as complete as biologists would wish it to be.

The council unanimously approved a plan to have the president of the Union appoint a committee to study the possibilities for expansion of interest in, and cooperation with, *Biological Abstracts* by the Latin-American countries.

Beginning January, 1942, *Biological Abstracts* is establishing a sixth section, Section F, entitled, "Animal Production and Veterinary Science." This has been done in order to provide for the needs of men employed in the animal industries.

A second general project with which the Union has been concerned is aid to the National Central Library of China. This project has recently been almost completely at a standstill, due to the war in the Far East.

Through one of its committees composed of E. V. Cowdry, F. L. Fitzpatrick, H. B. Glass, B. C. Gruenberg, O. Riddle and E. W. Sinnott, the Union has been investigating for a number of years biological science teaching in secondary schools. The final report of this committee was made by its chairman, Dr. Oscar Riddle. Two preprinted copies of the 76-page report were submitted to the Union Council. This report contained an analysis of 3,186 returns on a questionnaire sent to teachers of biology in secondary schools. Dr. Riddle stated that five of the six segments of this report had already been published earlier in the

American Biology Teacher. The sixth segment will appear in the January issue of that journal. Seven thousand copies of the complete report, entitled, "The Teaching of Biology in Secondary Schools of the United States—A Report of Results from a Questionnaire," are in press, and arrangements have been completed for mailing copies to biologists, educators and others throughout the United States.

Dr. Oscar Riddle, Carnegie Institution, Cold Spring Harbor, and Dr. Walter F. Loehwing, University of Iowa, were appointed to serve as representatives of the Union of American Biological Societies upon the recently formed "Cooperative Committee on Science Teaching." This latter committee also has representatives from the American Association of Physics Teachers, the American Chemical Society, the Mathematical Association of America and the National Association for Research in Science Teaching. This joint committee plans to consider certain problems (see Science, Vol. 95, p. 38, 1942) relating to the teaching of science in secondary schools.

The following officers were elected to serve for the Union of American Biological Societies during 1942: *President,* A. J. Carlson, University of Chicago; *Secretary,* F. A. Brown, Jr., Northwestern University; *Treasurer,* D. H. Wenrich, University of Pennsylvania; *Executive Committee,* B. M. Duggar, University of Wisconsin; A. P. Hitchens, University of Pennsylvania; G. W. Hunter, III, Wesleyan University.

Frank A. Brown, Jr.,
Secretary

Union of American Biological Societies

SPECIAL ARTICLES

THE PROCARCINOGENIC EFFECT OF BIOTIN IN BUTTER YELLOW TUMOR FORMATION[1]

Early in 1940 during the course of investigations which led to the demonstration[2,3,4] that biotin is identical with the anti-egg white injury factor (vitamin H), and that biotin is thus functionally involved in animal metabolism, experiments were initiated to ascertain whether or not biotin is a dietary factor present in liver and yeast which is protective against primary carcinoma of the liver induced in rats by the administration of N,N-dimethylaminoazobenzene (butter yellow). Protection against butter yellow by liver and yeast supplements had been reported by the Japanese workers.[5,6]

In two preliminary experiments two very crude biotin preparations, one from liver and one from yeast, were used as supplements to the butter yellow-brown rice-carrot basal diet which alone gave regularly a high incidence of tumors, namely, 96 per cent. at 150 days. Indications of a protective effect were obtained.

Other studies on protection against butter yellow revealed at this time that the addition of 200γ of riboflavin and 18 per cent. casein to the brown rice-carrot basal diet gave marked protection.[7] The tumor incidence at the end of 150 days was decreased from 96 per cent. to 7 per cent. This effect, though marked, was not as complete as that obtained by supplements of dried liver or yeast. Accordingly, the effect of the

TABLE I

Diets Employed

	Diet A*	Diet B	Diet C*
Brown rice	82 per cent.	..	81.5 per cent.
Casein (vit. free) ..	18 " "	15 per cent.	18 " "
Crisco	...	10 " "	..
Sucrose (C.P.)	...	60 " "	..
Egg white (dried) .	...	10 " "	..
Cystine	...	1 " "	0.5 " "
O. M. salt mixture .	...	4 " "	..
Supplements—Amounts per 100 grams of diet			
Choline	...	250 mg	160 mg.
Riboflavin†	1 mg	2 "	2 "
Thiamin	0.5 "	0.5 "	..
Pyridoxine	1 "	0.5 "	..
Nicotinic acid	5 "	2 "	..
Inositol	...	100 "	..
Pantothenic acid ...	2.5 "	1 "	..
Vit. A (concentrate)	...	4000 units	..
Vit. K (Me Naphthoquinone)	0.5 "	0.1 mg	..
Vit. E (*dl*, *a*-tocopherol)	...	1.0 "	..
Irradiated ergosterol	...	400 units	..
Ergosterol	100 "	...	..
N,N-dimethylaminoazobenzene	60 "	100 mg	60 "

* When diets A and C were used 1 gram of carrot was given per rat per day as used by R. Kinosita, *Trans. Japan. Path. Soc.*, 27: 665, 1937.

† 0.5 mg added in Diet B instead of 2 mg from 1st through 45th day.

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[1] Acknowledgment is made with full appreciation to Dr. Paul György for the crude liver concentrates used in these experiments and to the S.M.A. Corporation for supplies of biotin concentrates which made this investigation possible. A grant in support of this work to one of us (C.P.R.) from Standard Brands, Inc. is also gratefully acknowledged.

[2] P. György, D. B. Melville, D. Burk and V. du Vigneaud, Science, 91: 243, 1940.

[3] V. du Vigneaud, D. B. Melville, P. György and C. S. Rose, Science, 92: 62, 1940.

[4] P. György, C. S. Rose, K. Hofmann, D. B. Melville and V. du Vigneaud, Science, 92: 609, 1940.

[5] W. Nakahara, K. Mori and T. Fujiwara, *Gann*, (*a*) 32: 465, 1938; (*b*) 33: 13, 1938; (*c*) 33: 406, 1939; (*d*) 33: 57, 1939.

[6] T. Ando, *Gann*, 32: 252, 1938.

[7] C. J. Kensler, K. Sugiura, N. F. Young, C. R. Halter and C. P. Rhoads, Science, 93: 308, 1941. On the basis of independent investigations, P. György, C. E. Poling and H. Goldblatt (*Proc. Soc. Exp. Biol. and Med.*, 47: 41, 1941), have also obtained a protective effect of casein in the presence of riboflavin.

addition of other members of the B complex vitamins plus ergosterol and vitamin K, as given in Diet A, Table I, was next studied. Results shown in Table II indicate that these additional vitamins did not improve significantly the protection afforded by the riboflavin-casein supplement to the brown rice diet. In the hope of obtaining still more complete protection, several groups of animals were fed in addition to Diet A, 0.3 and 1.0γ of biotin respectively in the form of two concentrates, one 0.1 per cent. pure and the other (biotin ester) 25 per cent. pure. These animals appeared, however, to be less protected. Tumors were found in only 1 of the 9 animals on Diet A, whereas tumors were found in 13 out of 34 rats which had been given the biotin supplements in addition to Diet A.

TABLE II

Effect of Biotin on the Production of Hepatic Tumors by N,N-dimethylaminoazobenzene

Exp. No.	Diet	Biotin prep. used	Amount of biotin added daily	No. days on diet	No. rats surviving	No. rats with hepatic tumor
I	A	...	..	150-230	9	1
	A	0.1 per cent. conc.	0.3 γ	" "	8	3
	A	25 " " " (ester)	" "	" "	9	3
	A	0.1 " " "	1.0 "	" "	9	3
	A	25 " " " (ester)	" "	" "	8	4
II	B	....	..*	180	5	0
	B	crystalline	2.0 "	"	5	3
III	C	....	..	150–210	14	0
	C	crystalline	2.0 "	" "	11	6
		Summary of Results				
Exp. I, II, III		Controls	......		28	1
		Crude and crystalline biotin	0.3–4.0 γ		50	22
Exp. II, III		Controls	......		19	0
		Crystalline biotin	2.0–4.0 γ		16	9

* 4.0 γ crystalline biotin were fed from the 45th to the 115th day.

In view of this unexpected result, a further study was made of the effect of biotin added to highly protective diets. Crystalline biotin was used. Since only a limited amount of this material was available, the study was restricted to a small number of animals. A supposedly highly protective diet containing casein supplemented with cystine and choline was employed and sufficient egg white was added to produce a borderline biotin deficiency. It is to be noted that this diet did not contain the brown rice. The other constituents of the diet are shown in detail under Diet B, Table I. One group of animals was fed this diet alone and another group received in addition 2.0γ of crystalline biotin daily except from the 45th to the 115th day where 4.0γ were given daily. As is shown in the table, no tumors were found in the low biotin group at 6 months, whereas hepatomas were found in 3 out of 5 rats which had received the crystalline biotin.

While this experiment was in progress another experiment was made with the brown rice-carrot diet as the basal ration. Riboflavin, casein, cystine and choline were added (Diet C, Table I). No liver tumors were present at 150 to 210 days.[8] On the other hand, 6 animals out of 11, which in addition to Diet C had been given 2γ of crystalline biotin daily throughout this experimental period, showed well-developed neoplasms when sacrificed.

Thus in 3 sets of experiments in which rats were maintained on diets affording a high degree of protection, crystalline biotin and two biotin concentrates were found to "break through" the protection.[9] Moreover, this effect was obtained on two radically different diets; in one experiment no rice was used and in two a rice diet was employed. A combination of the data of these 3 experiments shows that only 1 rat out of the 28 control animals developed a liver tumor. However, when biotin (0.3 to 4.0γ) was added to these 3 diets, 22 rats out of a total of 50 developed liver tumors. A combination of the data of the 2 experiments in which crystalline biotin was used shows that, whereas there were no tumors in the controls (19 rats), 9 out of 16 rats fed the biotin had tumors. The preliminary experiments in which some protection was provided by the crude biotin preparations suggest the possibility that these crude preparations may also contain a factor which affords a small amount of protection which becomes apparent when a largely non-protective diet is used.

We feel that the results presented here justify the conclusion that biotin can exert a procarcinogenic effect when butter yellow is fed to rats receiving a highly protective diet. Whether biotin can break down the protection against butter yellow afforded by a yeast or liver supplement; whether the procarcinogenic action we have observed under our experimental conditions is a unique property of biotin; whether the effect can be extended to other carcinogenic agents and other species; and whether the reversed effect can be produced by a biotin deficiency (egg-white, avidin or other means), must all await further experimentation. The present data throw no light on these questions. We forego any discussion of the possible significance of the finding reported herein until further experimental data on these and related aspects are forthcoming.

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[8] A detailed report of our experiments investigating the protection afforded by riboflavin, casein, methionine, cystine and choline will appear at a later date.

[9] We have learned through private communication that György, Landy and Goldblatt have obtained with the biotin concentrate from liver (0.1 per cent. pure) a similar procarcinogenic biotin effect using a significantly protective diet. They found in an experiment involving 50 test and control rats that when 0.8 to 3.5 γ of biotin were administered daily to rats on a diet consisting of cooked polished rice and carrot supplemented daily with 20 γ of riboflavin, B_1, and B_6, tumor incidence was increased at 150 days from 33 to 52 per cent.

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PRELIMINARY OBSERVATIONS ON "EGG WHITE INJURY" IN MAN AND ITS CURE WITH A BIOTIN CONCENTRATE[1, 2]

It seemed important to determine whether any of the manifestations of spontaneous avitaminosis in human beings might be related to biotin deficiency. To this end a small group of volunteers ate a diet planned to contain a minimal amount of biotin; to this was added desiccated egg white in amounts sufficient to furnish approximately 30 per cent. of the total caloric intake. The diet was composed of 125 gm of polished rice, 80 gm of patent white flour, 75 gm of farina, 205 gm of cane sugar, 32 gm of lard, 10 gm of butter washed five times in hot water and 25 gm of lean beef. To this was added 200 gm of dehydrated but otherwise unmodified egg white. The basal components contained approximately 387 gm of carbohydrate, 31 gm of protein and 32 gm of fat with a caloric value of 1,960; the egg white contained 160 gm of protein and 32 gm of fat with a value of 928 calories. Such a diet is extremely poor in vitamins except riboflavin which is present in egg white in amounts approximating 10 mg per 100 gm. The daily vitamin supplement was:

Thiamin chloride	6 mg
Riboflavin	9 mg
Nicotinic acid	75 mg
Pyridoxine	5 mg
Ca. pantothenate	5 mg
Ascorbic acid	75 mg
Vitamin A	5,000 units

In addition, 1 gm of ferrous sulfate and 1 gm of calcium lactate were given daily.

It was possible to continue four subjects under observation to a satisfactory conclusion; three were white men, one a Negro woman. During the third and fourth weeks all four developed a fine scaly desquamation without pruritus. This disappeared spontaneously in seven to ten days. Thereafter nothing of significance was noted until the seventh week when one man developed a maculosquamous dermatitis of the neck, hands, arms and legs. During the seventh and eighth weeks all showed a pronounced grayish pallor of the skin and mucous membranes which was out of all proportion to the blood picture. During this same period the white patients showed atrophy of the lingual papillae, it was notable that the tongues remained pale with none of the capillary engorgement seen in pellagra or ariboflavinosis. During the ninth and tenth weeks all subjects showed increasing dryness of the skin with marked reticulation and a return of fine branny desquamation. No ocular or genital lesions were observed.

After the fifth week symptoms were prominent; these were strikingly like those noted in experimental thiamin deficiency. Mild depression progressed to extreme lassitude, somnolence and in two instances a mild panic state. Muscle pains, hyperesthesia without demonstrable neurologic changes and localized paresthesias were complained of by all. After the tenth week anorexia occurred with occasional nausea. Two patients complained of precordial distress and showed definite electrocardiographic changes.

Examinations of the blood at frequent intervals showed a definite diminution in hemoglobin content, the number of erythrocytes and the volume of packed red cells, there was slight increase in bile pigments and striking rise in the serum cholesterol. Determinations of biotin excretion in the urine showed that after seven to eight weeks of the experimental regimen the subjects excreted from 3.5 to 7.3 micrograms of biotin in 24 hours as compared with 29 to 52 micrograms excreted by individuals taking a normal diet.[3]

Treatment with an injectable biotin concentrate[4] has been completed in three of the four volunteers. The daily dose, administered in three aliquots, has varied from 75 to 300 micrograms; 150 micrograms seemed the minimal amount required for prompt relief. Depression, muscle pains, precordial distress and anorexia were abolished on the third to fifth days of treatment. Active distaste for the diet was replaced by willingness, even eagerness to eat it, although there was no significant increase in the amount consumed. The striking ashy pallor of skin and mucous membranes disappeared in four days. The elevated level of serum cholesterol was significantly reduced after

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[1] From the University of Georgia School of Medicine and the University Hospital, Augusta, Ga., and the Division of Chemotherapy, National Institute of Health, Bethesda, Md.

[2] This investigation was made possible by grants-in-aid by the John and Mary R. Markle Foundation and an anonymous donor and by donations of vitamins by many manufacturers. We gratefully acknowledge the constant help and valuable suggestions of Dr. R. E. Butler and the technical assistance of Mrs. Marjorie Bee.

[3] Biotin determinations made by Dr. H. Isbell, of the National Institute of Health.

[4] Biotin concentrate supplied by the S.M.A. Corporation, Chagrin Falls, Ohio.

one week. Insufficient time has elapsed for evaluation of other evidences of correction of physiologic disturbances.

Immediately after administration of 150 micrograms of biotin concentrate the urinary excretion rose from a deficiency level of 3 to 5 micrograms of biotin a day to a level approximating 55 micrograms. This excretion was maintained until the dose was increased to 300 micrograms when there was a further step-like increase in biotin excreted to 140–150 micrograms. When medication was discontinued there was an immediate fall in excretion to a level slightly lower than that found in persons eating a normal diet.

SUMMARY AND CONCLUSIONS

It has been possible to maintain human volunteers on a diet extremely poor in vitamins and in which approximately 30 per cent. of total calories was supplied by desiccated egg white. This was supplemented by seemingly adequate amounts of vitamins, iron and calcium. These individuals developed definite symptoms and signs, some of which were strikingly similar to those of spontaneous avitaminosis.

Symptoms and signs were rapidly cured by the parenteral administration of a biotin concentrate in doses representing 150 to 300 micrograms of biotin per diem.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

MICROBURETTE

THE principle of operation of the burette is that mercury is displaced by the spindle of a micrometer or by smaller spindles replacing the original. Moving an ordinary micrometer spindle through 25 mm displaces around ¾ cc, which is precisely divided into 2,500 parts. Since the measurement is based on the displacement of dry mercury, it is not affected by the amount of solution which adheres to the walls of the burette.

The anvil of the micrometer is replaced with a set screw (1). The lower part of the burette is a cylindrical reservoir with a plane ground, thick bottom and plane ground opening and an internal diameter just enough to clear the spindle. On the closed end of the reservoir is stuck a fiber ring (2) and next that a steel disk (3) with a center punch to receive the set screw. To the open end is stuck a fiber washer (4) greased with a heavy stopcock grease. The reservoir is fastened in the micrometer frame. Mercury will not leak through the spindle bearing when it is properly greased. If a small spindle is used, the fiber washer (4) must be reamed to a perfectly tight fit around the spindle which will be proof against leakage of mercury.

The micrometer frame is clamped to a convenient stand and mercury is sucked in to fill the reservoir. It is essential for calibration that no air bubbles remain in the reservoir. The last traces can be removed by applying vacuum suction to the burette tip. When the spindle is screwed out flush with the fiber washer, the enlarged bubbles can then readily be brought up into the funnel-shaped opening to the capillary. The reservoir is air free when there is no visible bouncing of the capillary column of mercury when the micrometer spindle is quickly moved and when no deviation from a mark occurs if the burette is tilted from vertical to horizontal.

For relative calibration it is convenient to have two ringmarks (5, 6) on the burette capillary at the same level. The volume between the marks is read on the micrometer by moving the mercury meniscus from one mark to the other in the dry burette. Some mercury is discharged and a new measurement taken, until the whole range has been tested.

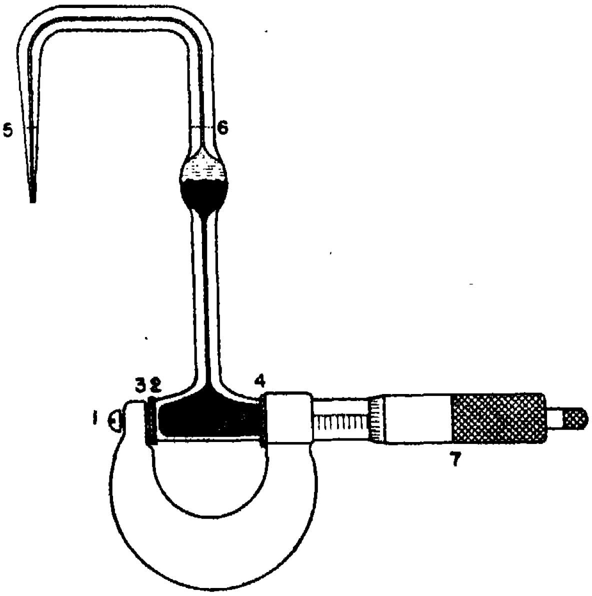

FIG. 1

The micrometers tested at our laboratory always came out with an accuracy corresponding to one fifth of the smallest divisions of the micrometer, *i.e.*, as close as could be estimated. Using the ordinary spindle this corresponds to an overall accuracy of around 1/10 mm^3 which amount corresponds to around one part in 10,000 of the total delivery capacity of the burette. The total capacity is determined by weighing the mercury delivered by full extension of the spindle. Temperature instability is practically avoided if the volume of the instrument is kept as small as possible. With considerate handling a water-jacket is not necessary.

The solution to be used is sucked into the bulb as shown in the figure and the instrument is ready for use. The size and shape of the burette can be varied according to the special purpose. It is an advantage that it is immaterial for the accuracy of the instrument how quickly the solution is delivered, for the measurement is not affected by solution which sticks to the walls of the capillary.

By replacing the original spindle with a drill rod of smaller diameter the total volume delivered can be reduced to very small limits and still permit accurate measurement of 1/10,000 part. For such a purpose the spindle and screw of the micrometer is first loosened from the thimble (7). The spindle is cut off and in its place is fastened by press fit a carefully alined drill rod of the requisite diameter. An accurate bushing is fitted in the original spindle bearing. The reservoir and washers of this smaller burette are correspondingly smaller, with a bore just large enough to clear the drill rod. The burette bulb likewise is made to correspond to the volume of the drill rod. By using 1/16 inch drill rod such a burette was found to measure delivered amounts with an accuracy of around 1/200 mm^3.

A microburette of this type is to be described later as part of a micro gas analyzer. The burette was made by J. D. Graham.

P. F. Scholander

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A METHOD FOR DETERMINING THE CONCENTRATION OF PROPYLENE GLYCOL VAPOR IN AIR

The discovery that propylene glycol vapor, dispersed in air in very minute concentrations, is capable of destroying air-borne bacteria and viruses[1,2,3] has made necessary the development of a technique for estimating the concentration of this gas in the air. A satisfactory procedure has been found to consist of bubbling 2-liters of the air through 10 cc of water with the aid of a sintered glass filter, and analyzing the propylene glycol content of the resulting solution by the method of Lehman and Newman,[4] modified to accommodate the smaller concentrations involved.

An efficient gas disperser can be made by sealing a circular disk cut from a fairly coarse fritted glass filter, into a glass tube, or can be bought from commercial supply houses. Complete absorption of the propylene glycol is obtained when the rate of sampling does not exceed 1/5 liters of air per minute. If rubber connections are used, the two glass tubes should touch inside the connector, as propylene glycol is quite soluble in rubber.

The contents of the test-tube are quantitatively washed into an Erlenmeyer flask. 1.00 cc of M/10 sodium periodate is added, and the sample is placed in an icebox for 15 minutes. At the end of that time, 5 cc of 7 per cent. $NaHCO_3$ is added, then 2.500 cc of N/10 Na_3AsO_3, followed by 0.2 cc of freshly prepared 20 per cent. KI. The solution is allowed to stand for 15 minutes at room temperature, after which 1 cc of 1 per cent. starch solution is added, and the solution titrated with 0.01N I_2 solution. A blank is run through the same procedure, and the number of milliliters of I_2 solution used in the blank is subtracted from that required by the sample. One cc of .01N I_2 solution is equivalent to 0.38 mgs of propylene glycol.

This procedure has been checked by analysis of samples of air into which known amounts of the glycol have been vaporized. The method is accurate to within .05 mgs of propylene glycol in the analyzed sample. When very dilute mixtures of propylene glycol are being determined (0.1 mg per liter or less), it is therefore necessary to use 4 to 6 liters of air for each sample.

Theodore T. Puck

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[1] O. H. Robertson, Edward Bigg, B. F. Miller and Z. Baker, Science, 93: 213, 1941.

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RECENT ARCHEOLOGICAL RESEARCH IN LATIN AMERICA[1]

By Dr. WM. DUNCAN STRONG

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Highly important anthropological research is in progress in Latin America at the present time. Inaugurated prior to the entry of the United States into the war, this work is an aspect of a long-time program of scientific and cultural cooperation between the American republics. These studies include ethnological and sociological research among various highland and lowland communities, physical studies among modern and ancient populations, and, as would be expected in one of the world's richest archeological areas, much exploration and stratigraphic excavation in the ancient ruins. In all Latin America, archeology, ethnology, history and sociology blend into one closely interrelated and fascinating problem of cultural and racial interaction, an understanding of which is as important to the practical statesman as it is challenging to the social scientist.

During the last year the Institute of Andean Research, working under the auspices of the Office of the Coordinator of Inter-American Affairs, has placed ten parties in this vast field working in close cooperation with the scientists of the various Latin American countries. The present program of the Institute of Andean Research—ranging from northwestern Mexico to Chile—aims at completing and publishing on a series of stratigraphic excavations in certain key areas which will assist in developing a sound and uniform chronology for the major cultures of the New World. Such a temporal framework is essential for any understanding of the interrelationships that existed between the high civilizations of Middle and South America and their influence on native North America. It has, moreover, a direct bearing on many modern historic, geographic and botanical problems of economic and sociological importance. Furthermore, the program as envisaged helps toward an understanding by each country of its own history; it brings a North American personnel of mature scholars and promising graduate students into creative contact with the Middle and South American fields; and by association with scholars in the various countries it provides for intellectual exchange and mutual understanding. Through the employment, where possible, of young regional archeologists it cross-fertilizes the technical disciplines in use and, by the publication of results, provided for in the plan, it makes permanent and available to all the scientific results of the work. There has been in many Latin American countries a very just pride in their Indian past. Such a program as this recognizes that pride and stimulates our own interest in the first colonizers and economic developers of the American continents.

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[1] Address of the retiring vice-president and chairman for the Section of Anthropology, American Association for the Advancement of Science, Dallas, Texas, December 30, 1941.

Preliminary to the inauguration of this program Dr. George C. Vaillant, chairman of the Institute of Andean Research, made a rapid survey trip, visiting the various countries where work was proposed. In each he found both sympathetic interest and cordial cooperation which made the arrangement of technical details a mere matter of routine. Subsequent to his report the various field parties began their work, which is now in full progress. Due to this fact it is obviously impossible to give anything approaching a complete summary, but it is believed that a preliminary and partial report may have value at this time. In so doing an attempt will be made to indicate the manner in which these specific projects tend to interdigitate with various national or institutional research programs now in progress in Latin America.

Project 1, in northeastern Mexico, has for its director, Dr. George C. Vaillant, and its supervisor, Dr. Gordon Ekholm. With the full cooperation and assistance of Dr. Alfonso Caso, director of the Institute of Anthropology and History, and his colleagues, Dr. Ekholm is now conducting excavations in the Tampico region. A brief survey of border sites near Laredo, Texas, revealed non-ceramic sites as well as stone-faced, rubble mounds containing pottery and tobacco pipes, some of which were of platform type. In central San Luis Potosi, a more advanced culture than that of the historic Karankawa was investigated at Buena Vista. Here both round and rectangular stone-walled mounds were excavated and various types of painted, incised and negative painted ceramics encountered. The round buildings suggest Huastec types, but the ceramics are different. Preliminary analysis suggests that the latter are related to wares from the early levels at Tajin and to certain types from Teotihuacan. Prior to the peoples of low culture present in this area in historic times, it appears that a sedentary, agricultural people occupied the region, possibly in Late Teotihuacan times, having relationships with both the Tajin and the Tarascan peoples of that period. Subsequent excavations near Tampico revealed plaster-covered conical mounds with stairways, in one case consisting of six superimposed layers. These contained burials accompanied by pottery which shows strong Mixteca-Puebla connections. Excavations in this region are still in progress.

Project 2, in western Mexico, includes Dr. A. L. Kroeber as director, Dr. Carl Sauer as co-director and Dr. Isabel Kelly as supervisor in direct charge of operations. The first portion of Dr. Kelly's work included both surveys and potsherd analyses in Guadalajara. The results of this survey correlate well with native settlement data in historic documents of 1525, and reveal that the majority of sites pertain to a ceramic complex dominated by Autlan Polychrome ware. There are three major ceramic complexes in this region, two date from the time of the Conquest and one is earlier. At the request of the Institute of Anthropology and History work is being carried on for some time in the vicinity of Apatzingan, Michoacan. This is proving interesting but difficult, as sites appear to be rare and material scarce. However, progress has been made in distinguishing the local cultures and toward correlating them with Colima cultures already distinguished in previous work. Further work is planned in the Tuxcacuesco-Sayula zones of Jalisco, where both local and Colima cultures occur and where evidences of aboriginal copper-working have been reported. As in the case of Dr. Ekholm, the work of Dr. Kelly has been fitted into the broad program now being so successfully prosecuted by the anthropologists of Mexico. Like the recent investigations of the National Geographic Society and the Carnegie Institution in the Vera Cruz region, this new work to the west and northeast fits in with the national program of Mexico and tends to link important areas heretofore isolated through lack of scientific exploration.

While much still remains to be done, the Maya area of Yucatan and Guatemala is relatively well outlined, thanks to the work of the Carnegie Institution and other scientific and national agencies. For this reason no projects were proposed here at this time. On the other hand, San Salvador, one of the most heavily populated Central American countries, and highly important from the archeological standpoint, is little known. Project 10, with Dr. A. V. Kidder as director and John Longyear as supervisor, was therefore located in San Salvador. After preliminary study of national and local collections in this country, Mr. Longyear made an archeological survey of the trans-Lempa river region and, at San Andres in the western part, conducted excavations. Working in conjunction with the Carnegie Institution he has also uncovered deep deposits separated by a volcanic stratum at the great Quelepa site. These excavations promise to throw considerable light on the present obscure sequence of prehistoric cultures in this part of Central America.

To the east, the great Antilles chain extending from Florida to Venezuela likewise tends to link the northern and southern American continents. To extend work already accomplished here, and to specifically attack this problem, Project 5, including Venezuela and the West Indies, was established. Dr. Cornelius Osgood is the director of this project, Dr. Irving Rouse, associate director, with Dr. Carlos Garcia-Robiou as supervisor for Cuba and George Howard for Venezuela. At present Dr. Garcia-Robiou is continuing excavations in Cuba and Mr. Howard is excavating and making further surveys in Venezuela. During the last summer Drs. Osgood and Rouse excavated a number of midden and cave sites and made surveys in both the eastern and the western portions of Cuba. The excavations yielded extensive information on the preceramic Ciboney culture and indicated various culture sequences elsewhere. In Venezuela, Dr. Osgood and Mr. Howard made intensive surveys along the northern coast and up the Orinoco river. Sites were visited in the savannahs of the upper Tigre and Guanipa rivers and the center of a new culture located near the town of Barrancas on the lower Orinoco. Examination of the delta region of the Orinoco gave no indication of sites, which accords with the general nature of the country. Excavations were carried out on the north shore of the Gulf of Paria, and Dr. Osgood also made a survey of the island of Trinidad. Here he discovered archeological evidence which, in his opinion, unquestionably and objectively proves the long-assumed connections between South America and the West Indies. The survey was extended through western Venezuela and work is now in progress in certain sites thus indicated as having particular importance. In this work the cordial cooperation and assistance of the Cuban and Venezuelan governments and scientists, as well as that of various oil companies, has been invaluable.

In South America several projects are operating particularly along the west coast and in the adjacent highland areas. Colombia, the home of the Chibcha and other important higher cultures, is as yet in the stage of regional or geographical surveys as concerns its archeology. Project 6, in Colombia, includes Dr. Wendell Bennett as director and James A. Ford as supervisor. Dr. Gregorio Hernandez de Alba, director of the museum and well known for his work at San Agustin and in the Tierradentro, as well as Dr. Luis Alfonso Sanchez, assistant director of the museum, are both participating in this work in addition to their own researches. Dr. Bennett and Mr. Ford have also received valuable advice and assistance from the famous anthropologist, Dr. Paul Rivet, now director of the Institute of Ethnology in Bogota and formerly head of the Musée de l'Homme in Paris.

Project 6 includes a general survey of Colombia, part of which was accomplished this summer, and intensive excavation in the Cali Region on the middle Cauca River between Quimbaya and the Tierradentro regions. Excavation in this area has already isolated new cultural materials in hollow shaft tombs. From five of these tombs came more than five hundred pottery vessels, two hundred from one tomb alone. Despite such finds, however, lack of large ruins makes location of sites difficult. Refuse deposits appear to be both rare and thin. Ancient house platforms, sometimes faced with rough stone, occur on ridges facing the valleys. Such house platforms range around ten meters in diameter and occur in clusters of as many as three or four hundred. Many olla fragments occur in these sites. Burial tombs are usually made in the outside slopes of house platform. They are usually shafts about one half meter in diameter reaching to a depth of two meters with vaults on the uphill side of the shaft. Larger tombs contain ollas with human bones, but others contain little else than bundle burials of single individuals. The house structures themselves were impermanent, no large ceremonial centers have been noted, and agriculture seems to have been of the temporary or milpas type. Mr. Ford is now engaged in excavation farther east in the mountains. It is hoped that this work as a whole will not only throw light on chronology but may also give some evidence of connections between the high cultures of Central America to the north and those of the Ecuadorian and Peruvian regions to the south. The area is vast and it is obvious that much work must still be accomplished before the work of Preuss, Hernandez de Alba and others around San Agustin can be linked with that of Mason in the Tairona country or with Central America proper.

In Ecuador Project 9B is under the directorship of Dr. Fay-Cooper Cole, with Dr. Donald Collier as supervisor and J. V. Murra as assistant supervisor conducting the field work. After study of collections and data in Quito, as well as various surveys in which they have been assisted by Ecuadorian students, Dr. Collier and Mr. Murra have moved south in the highland region, where they are finding interesting sites. This project started somewhat later than the others and more detailed reports are not available. Thanks to the pioneer work of Dr. Jijon de Caamaño and a survey now in progress by the School of American Research at Santa Fé under Edwin N. Ferdon, Jr., it has been possible for Dr. Collier and his assistants to secure important guidance in attacking the problem of Ecuadorian culture sequences.

In the north central highlands of Peru another project is operating. This is Project 9A under the directorship of Dr. A. L. Kroeber, with Dr. Theodore McCown as supervisor in charge of field operations. Dr. McCown has received advice and much assistance from various Peruvian archeologists, including Dr. Luis E. Valcarcel, Dr. Julio Tello, Sr., Rafael Larco, as well as many other local authorities. After accomplishing some survey work on the north coast of Peru, Dr. McCown proceeded inland to the famous but little known site of Marca Huamachuco. Here he cleared and mapped a considerable part of the site since the plans made some years ago by Dr. Max Uhle have been lost. Excavation has revealed a variety of architectural types, carved stones and ceramic wares. The entire site appears to be pre-Inca. At last reports Dr. McCown was moving to Viracochapampa, north of Huamachuco, and hoped later to excavate at a previously unexplored site to the east. Ceramic and architectural sequences from this important but little known area should have great importance.

Farther to the south in the Peruvian Highlands, adjacent to Lake Titicaca and Bolivia, Project 7 is in operation. This South Peruvian Highland project has Dr. Alfred Kidder II as director, John Rowe as supervisor and Mrs. Harry Tschopik, Jr., as assistant supervisor. During the past summer Dr. Kidder and his assistants completed a reconnaissance of that portion of the Titicaca basin included in Peru. Many sites, both late and early, were discovered, including burial towers (chulpas), houses and forts. An interesting example of the latter type is the fortress near the temple of Pucara. This structure, referred to in the Inca chronicles, had hitherto been unreported. Numerous sites on the very early Tiahuanaco-Pucara culture level were found, and it is hoped that later excavation may solve the riddle of the temporal relationship of these two important highland cultures. Classification of pottery types, in addition to the surface and stratigraphic surveys, give good promise in this regard. Mr. Rowe, subsequent to visiting sites recently uncovered by the Wenner-Gren Expedition near Machu Pichu, is now engaged in stratigraphic excavations in the vicinity of Cuzco. These should throw light on the development of Inca culture and its relationship to the earlier cultures of the adjacent highland region. This project is closely coordinated with the highland work of such Peruvian scientists as Dr. Luis E. Valcarcel, and others; and indirectly with that of Dr. Arturo Posnansky and his colleagues in Bolivia; and with the long-range ethnic and archeological program of the Peabody Museum of Harvard University.

Regarding the central and southern coasts of Peru, two projects are being undertaken. One of these (Project 8) is under the directorship of Dr. S. K. Lothrop, assisted by Counsellor Dr. Julio Tello, with Dr. Marshall Newman as supervisor. The cultural side of this work includes the preparation and publication of the vast data resulting from Dr. Tello's excavations at the very rich and important site of Paracas. The physical anthropology of the early Necropolis and Cavernas cultures of Paracas is being undertaken by Dr. Newman. In addition, Dr. Newman is cooperating in physical studies of the human materials secured by Project 3, mentioned below. Both the cultural and physical studies under Project 8 are well advanced and the work continues.

The second coastal project in Peru (Project 3) includes Dr. W. D. Strong as director and Gordon Willey as supervisor. Dr. Strong was in the field during the past summer and the work is continuing under Mr. Willey, assisted by John Corbett. Thanks to the unstinted assistance and cooperation of Dr. Tello, Dr. Valcarcel and other Peruvian archeologists, this project has achieved considerable success in intensive stratigraphic excavations in rubbish heaps with the primary purpose of defining ceramic types and sequences. As a result of the invitation of Dr. Tello, who for several years has been intensively excavating at Pachacamac, it was possible for Dr. Strong and Mr. Willey to make a deep stratigraphic cut at this very famous coastal site. This cut, made in a great refuse heap outside one entrance of the Temple of the Sun, revealed two meters of abundant Inca refuse, including other later ceramic styles, while below this were eight meters of deposit containing Interlocking or Proto-Lima pottery and an undescribed negative style. No indubitable Tiahuanaco-Epigonal sherds were encountered, but there is evidence that this intrusive style falls temporally between the Inca and the Interlocking. Thus, to the Inca-Tiahuanaco and Epigonal sequence encountered at this site by Dr. Uhle there is now added a long occupation by a local people who made the Interlocking or Proto-Lima type pottery. The depth of this Pachacamac deposit, some forty feet, and the great abundance of potsherds from all levels convincingly demonstrates the great possibilities awaiting the refuse heap-potsherd stratigraphic method which, until the present, has rarely or never been successfully employed in Peru. In addition, one small tomb encountered adjacent to this cut yielded nearly one hundred excellent skeletons pertaining to the early Pachacamac-Interlocking period. These were removed by Dr. Newman and will be reported on by him. More recent work by Mr. Willey in the Chancay valley has added to this ceramic sequence. Here, at Cerro de Trinidad, he encountered several meters of consolidated refuse containing Chancay White-on-Red pottery beneath refuse containing Interlocking pottery styles. This was also confirmed by finding a large White-on-Red tomb under undisturbed floors of the Interlocking period. This discovery not only adds an earlier coastal type of ceramics to the Pachacamac sequence but also, on the basis of actual superimposition, reverses Uhle's and Kroeber's conclusions that White-on-Red ceramics were intrusive in Interlocking style tombs and were therefore later. Space is lacking to more than mention excavations already made or in progress yielding incised pottery of Early Ancon (or Coastal Chavin) type. This is the earliest ceramic type yet encountered in the general region and apparently represents a basic and wide-spread Peruvian culture. In certain aspects it approaches a truly Archaic level. Furthermore, certain evidences encountered suggest the presence on the central coast of a pre-ceramic culture, but these are as yet not entirely clear.

In coastal Chile, a pre-ceramic culture has long since been reported by Latcham and Uhle. Recent work by Junius Bird, supervisor of Project 4 (under the same directorship as Project 3), has objectively confirmed this fact and stratigraphically placed the horizon. In the Arica region, Mr. Bird has encountered several stratified sites which run the gamut from hunting peoples of lithic culture to agricultural peoples with pottery, weaving and metals. Not only is direct superimposition present, but it also appears possible to work out many details of development and diffusion regarding horticulture, domestication and technical advance. Work farther to the south in the vicinity of Taltal is now in progress. More detailed results will be reported at a later time.

In conclusion, it must be emphasized that the foregoing is a mere "work in progress" report and stands in need of some correction and much amplification. It is, however, already obvious that detailed stratigraphic excavations in Latin America are yielding rich theoretical results. One thing is certain and that is that there is no lack of stratified refuse deposits on the Peruvian, Chilean and adjacent coasts. It will take time, skill and much hard work to get their full story, but when we do the rich record of ruined city and gorgeous grave find will fall into order and assume cultural meaning within a historical frame. The discoverer of America was not Columbus nor did the European create those great agricultural and economic resources which revolutionized the post-Columbian world. There is much to be learned, both socially and economically, from the past and present achievements of the American Indian, and he would be provincial indeed who regarded such facts as merely academic. Thus, the work continues on a broad front with the close cooperation of North, Central and South American scientists. Its aim is a deeper knowledge and a better application of those vast human and ecologic resources which pertain to the western hemisphere but, in the future as in the past, will actually affect the entire world.

THE PROBLEMS OF AGING AND OF VASCULAR DISEASES[1]

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THE PROBLEM OF AGING

THE medical problem of aging is more concerned with prolonging the stamina of youth and middle age than with extending the lives of the aged. It is hoped that we may delay senility rather than prolong it. Although aging has numerous manifestations, such as loss of hair color, of muscular tone and of sex activity, the average individual is most concerned with two manifestations, namely, the progressive loss of physical and mental ability on the one hand and the rapidly increasing death rate with age on the other hand.

The increasing death rate appears to be the only manifestation of aging which, during adult life, shows wide changes that are subject to accurate measurement. A study of the mortality data brings out the great importance of the problem of aging. Human death rate is at a minimum at the age of ten when only one child in 800 dies each year. If the death rate remained at this level throughout the whole life span our life expectancy would be 550 years, instead of 63 years as at present. In reality our death rate increases 8 per cent. each year throughout the life span until the mortality among elderly people is very high.[2]

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[1] Part of the material in this paper was presented at the Symposium on Aging at the American Chemical Society meetings in Atlantic City, September 9, 1941. The investigation has been aided by grants from W. R. Warner and Company and the John and Mary R. Markle Foundation.

In Fig. 1 it may be seen that if in the United States in 1936 there had been only one death in 800 among people of all ages above ten, there would have been only one tenth as many deaths as actually occurred. These are represented by the white columns at the bottom. The other 90 per cent. of the deaths, *over a million a year in the United States,* result from the increase in death rate with age. Even among people in their early twenties the majority of deaths are due to this increase in death rate with age. Many of these excess deaths may be attributed to the progressive loss of resistance to disease as a result of an underlying aging process.

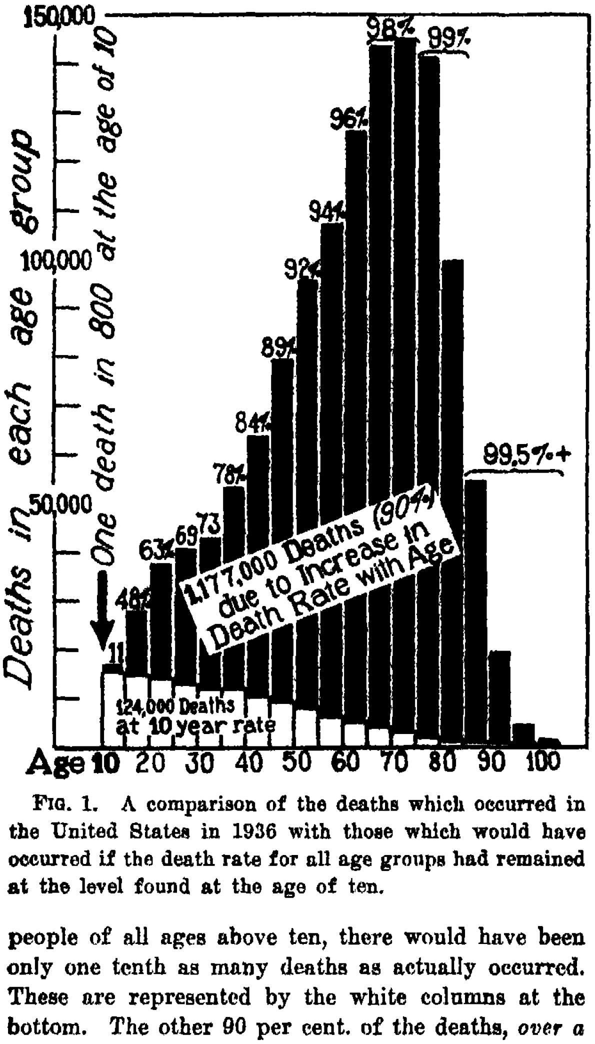

FIG. 1. A comparison of the deaths which occurred in the United States in 1936 with those which would have occurred if the death rate for all age groups had remained at the level found at the age of ten.

In accounting for the enormous effect of age on death rate we must distinguish between the "aging process" and the random accumulation of pathological injuries (such as damage from acute infections, from tuberculosis, from silicosis or other industrial hazards, cirrhosis of the liver, nephritis and perhaps arteriosclerosis). Such random injuries should follow a linear relationship with age (except in so far as one injury may accentuate another) and, hence, can not account for the observed increase in death rate[3] which follows a logarithmic equation.[2]

We may therefore conclude that this decreasing resistance to disease is largely the result of *an underlying process of aging which involves the progressive alteration of vital physiological functions.* This "process of aging" may include such progressive changes as those occurring in the blood vessels (including thickening, distension, loss of elasticity or of capillary permeability), diminished vital capacity, changes in metabolism or of water balance or resistance to shock, alteration of endocrine glands and any "wearing out" of tissues or gradual accumulation of metabolic products.

Since loss of physical and mental ability is correlated with diminishing resistance to disease[2] it is to be expected that any amelioration of one manifestation of aging may be reflected in the other.

VASCULAR DISEASES

If we accept aging as our most important medical problem then our second most important problem is vascular diseases. With improved treatment of infections the vascular diseases are becoming increasingly important. In Table I it will be seen that in 1938 in the United States nearly 50 per cent. of the

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[2] Henry S. Simms, SCIENCE, 91: 7, 1941. In this paper it is shown that the death rate at age t (for either total deaths or for individual diseases) follows the empirical equation $\log P_t - \log P_0 = kt$ where k indicates the rate of aging. Loss of ability follows the same equation.

[3] In so far as one injury may augment another, a logarithmic curve might be obtained; but it is questionable that such a mechanism can account for the 250 fold increase in total deaths between the ages of ten and ninety, or for the 2,000 to 10,000 fold increase in deaths from vascular diseases, without consideration of the aging changes in the blood vessels. Senile debility is correlated with senile mortality and may involve the same mechanism, yet it seems unlikely that progressive physical and mental debility result from accumulated injuries to the various organs rather than from progressive alterations in the circulatory and glandular systems, for example. A few elderly people, while showing no significant pathological damage, become disabled and die within the usual life span. If accumulated injuries were the cause of senile mortality we would expect occasional authentic cases of individuals living to astounding ages such as 150 years, but such is definitely not the case. It was shown by Brody (*Univ. of Mo. Agr. Exp. Sta. Res. Bull.* 105, 1927) that the mortality of drosophila also follows a logarithmic curve similar to that for humans but much steeper. It is difficult to imagine that within the short life span of these insects there is the opportunity for the accumulation of sufficient pathological injuries to produce a many-fold increase in the death rate. Delayed deaths, as in nephritis or cancer, also fail to explain the increased death rate, since the mortality from such diseases involves logarithmic aging curves which are merely displaced along the time axis according to the duration of the disease. Although some of the delayed deaths resulting from rheumatic fever are probably included in the black columns of Fig. 1 these should not account for any predominating portion of the increase in death rate.

TABLE I

RELATIVE IMPORTANCE OF THE VARIOUS PATHOLOGICAL CAUSES OF DEATH AFTER THE AGE OF TEN*

In each disease group, except pregnancy and childbirth, the majority of deaths may be attributed to the loss of resistance to the diseases as a result of aging

Disease or diseased organ	No. deaths	Per cent.
Cardiovascular-renal disease[4] (*Heart and arteries 376,907; cerebral hemorrhage 111,073 and chronic nephritis 90,459*)	578,439	48.
Infectious diseases (General infectious and parasitic diseases† 96,542; respiratory 75,691; other specified organs 25,739)	197,972	16.
Cancer and other tumors	154,551	13.
Accidents and violence	112,405	9.
Digestive system (except infections)	50,744	4.
Glands and nutriton	39,137	3.
Genito-urinary system (except chronic nephritis)	27,515	2.
Nervous system (except cerebral hemorrhage and infectious diseases)	11,350	1.
Pregnancy and childbirth	9,953	0.8
Blood and blood-forming organs	9,374	0.8
"Senility"	9,242	0.8
Ill defined and miscellaneous	17,713	1.5
	1,218,395	100.

* Rearranged from the United States Vital Statistics for 1938.

† Including 12,728 deaths (1 per cent.) from influenza and 1,952 deaths (0.16 per cent.) from other filterable viruses and rickettsia.

deaths after the age of ten involved diseases of the cardiovascular-renal system.[4] The importance of these diseases is far out of proportion to amount of research being done in this field or to the support received from foundations and research institutions.

Vascular diseases are more prevalent in later life because the death rate from them increases with age more rapidly than from other diseases[2] and because, being chronic, they produce a delayed death.

RESEARCH

Our present knowledge does not warrant a prediction as to the outcome of research on aging and on vascular diseases. There is no justification for the frequent assumption that these are inevitable or that nothing can be done about them. We have as much reason to hope for a retardation in the rate of aging as for a cure for hypertension, cancer, cirrhosis and other diseases which are extensively studied. It can be shown mathematically that whereas the elimination of all remaining infectious diseases would only slightly increase our life span, it would require only a small amelioration of the rate of aging to greatly delay the onset of senility and also extend the life span considerably.

A new method of attack has been developed in this laboratory. Healthy rats in various age groups were killed by a known and measurable cause, namely hemorrhage. The amount of bleeding required to produce death under standard conditions is determined and expressed as "grams of blood per 100 grams of body weight." It was found that 825-day-old rats died with 12 per cent. less hemorrhage than 100-day-old rats. With the aid of a distribution-summation curve these values were converted into probability of death from a given degree of hemorrhage (such as 3.6 per cent. bleeding). The older rats were found to have a probability of death 16 times greater than the younger rats and a plot of the values resembled the curve for spontaneous deaths of rats from disease.

Variations of this technique offer encouraging possibilities for determining the nature of the underlying aging process. Other needed research on aging includes the study of changes in blood vessels, in endocrine function, in metabolism, etc.

FINANCIAL NEEDS

The principal reason for the present neglect of the problems of aging and vascular diseases is not so much the difficulty in their solution as the difficulty in obtaining financial support. Much of the current medical research depends upon grants from the foundations. These foundations restrict themselves mainly to short-term grants, while the problems of aging and vascular diseases can not be adequately investigated by short grants which require quick dramatic results. In discussing grants from foundations, Dr. Alan Gregg, of the Rockefeller Foundation, wisely says,[5] "The good effects . . . are sadly qualified by the continuing preference for short-term grants instead of endowment or long-term support."

The adequate investigation of aging and vascular diseases requires endowments or long-term renewable grants because the study of these problems is handicapped by any demand for quick results. Furthermore, continuous animal colonies are needed to supply old animals and these must be supported for an indefinite number of years. It requires two and a half to three years to raise each old rat or mouse and a laboratory may use $2,500 to $5,000 worth of animals per year.

POSSIBLE SOURCES OF FUNDS

There are several ways in which this situation might be relieved. First, if new foundations are established they might manifest specific interest in aging, or they might adopt the policy of distributing their funds equitably in accordance with the relative importance of the problems without taboo on either long-term grants or on renewals. Second, the existing foundations might alter their policies to meet present needs, as advocated by Dr. Gregg. Third, endowments for research on aging and vascular diseases might be donated by foundations or by individuals to various medical schools and institutions. An annual income of $50,000 or $100,000 could well be used for this purpose by each medical school. Fourth, federal support is highly desirable, but its present program is quite inadequate. Fifth, popular subscription, which has aided treatment of tuberculosis and poliomyelitis, might yield support for medical research.

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[4] In the "diseases of cardiovascular-renal system" are included arteriosclerosis, coronary diseases, cerebral hemorrhage, chronic nephritis and other diseases of the heart and arteries. This is similar to the grouping used by Dublin, "The Mortality from the Principal Cardio-vascular-Renal Diseases," Metropolitan Life Insurance Co., N. Y.

[5] Alan Gregg, "The Furtherance of Medical Research," Yale University Press, New Haven, 1941.

Some sources of funds for the study of aging and vascular diseases on a larger scale than is now possible is urgently needed and should be established in the immediate future.

SUMMARY

The increase in death rate with increasing age over that at the age of ten accounts for over a million deaths each year in the United States. To what extent these deaths are due to the aging process remains to be determined, but the progressive loss of resistance to nearly all diseases appears to play a large role even in youth and middle life. Since loss of resistance to disease, as well as loss of ability, seems to result from an underlying aging process we may look upon aging as constituting our greatest medical problem.

Second in importance to the aging problem is that of the vascular and renal diseases, since these are involved in nearly 50 per cent. of the deaths after the age of ten (in addition to the effect of aging).

Until more is known about aging and vascular diseases we are not justified in predicting what can or can not be done about them. A new experimental method in which healthy animals of different ages are killed by a known measurable cause offers possibilities for determining the nature of the aging process.

Our two outstanding medical problems are being neglected largely because of the lack of funds to support both the long-term research and the raising of old animals needed for adequate investigation in this field. New endowments as well as changes in the policies of existing foundations are urgently needed.

Supplementary Note: The war situation which has arisen since this paper was written does not lessen the urgent need for endowments in aid of research on aging and vascular diseases. The deaths from these causes, even among young and middle-aged people, will far exceed the war casualties. Diminished stamina after the age of 40 handicaps both our military and our productive capacity. Hence, continuous colonies of animals should be established immediately in order that old animals will be available for intensive research two or three years from now.

OBITUARY

CHARLES WILLIAM LINES, JR.

September, 1920–January, 1942

CHARLES W. LINES, JR., fellow in botany at the University of Wisconsin, died suddenly on January 9, in Oxford, Miss. (Hospital), as a result of injuries sustained in an automobile accident near there on January 3. He was enroute to Madison, Wisconsin, from Dallas, Texas, where he had attended the Christmas meetings of the American Association for the Advancement of Science as a representative of the Zeta Chapter of Phi Sigma.

He was born in Du Bois, Pa., September 24, 1920. After receiving public-school education at Du Bois, he entered Penn State, where he pursued a varied curriculum, graduating in botanical sciences in 1939. After one semester as a graduate student at Penn State, he went to the University of Wisconsin as a scholar in botany. He was made a fellow in botany for 1941–42.

Among the many accomplishments and endeavors which, despite his chronological youth, were many, his work at the University of Wisconsin was concerned mainly with physiology of fungi, while others, such as wild life conservation, plankton zoology, limnology, ecology, botanical taxonomy and physical chemistry, shared much of his eager interest and time.

He was a member of several scientific and honorary societies, among which were Phi Beta Kappa, Sigma Xi, Phi Sigma and the American Association for the Advancement of Science.

As a scientist Charles Lines was a conscientious, persevering and scholarly person. His future seemed pointed toward unbounded successes and scientific accomplishments. It is sad indeed to have to report the premature termination of such a promising career.

CLASSMATES AND FRIENDS
UNIVERSITY OF WISCONSIN

RECENT DEATHS

DR. ARTHUR MICHAEL, appointed professor of chemistry at Tufts College in 1881; professor of organic chemistry at Harvard University since 1912 and emeritus professor since 1936, died on February 8 in his eighty-ninth year.

DR. LAWRENCE J. HENDERSON, Abbott and James Lawrence professor of chemistry at Harvard University, died on February 10 at the age of sixty-four years.

DR. SAMUEL W. LAMBERT, formerly professor of clinical medicine and dean of the College of Physicians and Surgeons of Columbia University, died on February 9 at the age of eighty-two years.

DR. JACOB ELLSWORTH REIGHARD, professor of zoology at the University of Michigan until his retirement with the title emeritus in 1927, died on February 14 in his eighty-first year. He served for forty-one years on the faculty and for seventeen years as director of the university museums.

DR. WILLIAM DICK CUTTER, secretary of the Council on Medical Education and Hospitals of the American Medical Association since 1931, from 1923 to 1928 dean of the New York Post-Graduate Medical School, died on January 22 at the age of sixty-three years.

ARTHUR HENRY PRATT, consulting civil engineer and chief hydraulic engineer of the Public Service Commission of New York, died on February 1 at the age of sixty-seven years.

MERRILL J. MACK, professor of dairying at the Massachusetts State College, died on February 9. He was thirty-nine years old.

SCIENTIFIC EVENTS

NEW HAVEN INDUSTRIAL MEDICAL SERVICE

NEW HAVEN COUNTY physicians in cooperation with the Department of Preventive Medicine of the Yale School of Medicine have approved the creation of an Industrial Medical Service in factories which do not now have adequate medical service.

Plans have been drawn up for the organization of the service in five plants in New Haven County, each having a personnel of not more than 300 persons. The service will consist of a director, who shall be a physician trained in industrial medicine and is to be responsible for administration and for meeting problems in industrial hygiene, and a nurse trained in industrial medicine. A grant to defray some of the initial expenses has been made by the New Haven Foundation.

"It is estimated that two years will be required to determine whether this service is justifiable and worth continuing or not. At the end of this period the Section of Preventive Medicine of the Yale School of Medicine will review the project. The opinion of the New Haven Medical Association will be solicited at that time."

The functions of the proposed Industrial Medical Service will be:

1. To serve as a demonstration that adequate medical service for small plants is possible.
2. To act in a consultative capacity for those plants in determining the nature of actual or potential hazards (such as the introduction of new factory methods) and to render advice concerning their correction and avoidance. This service is to complement rather than to supplement the service available to industry by the Bureau of Industrial Hygiene of the State Department of Health.
3. To initiate programs of disease prevention in those plants when they seem necessary or advisable. This does not include medical care, which remains in the hands of the family physician.
4. To arrange for pre-employment and periodic physical examinations. These will be given by local physicians.
5. To carry on research problems which have to do with the health of workers in various types of industries and to use the data in an effort to decrease the incidence of disease.

A committee from the New Haven Medical Association will censor the operation of the plan to handle any complaints and any proposed changes. A monthly list of accidents and illnesses in those plants which use the service will be examined by the committee.

HEALTH SERVICES OF THE COMMONWEALTH FUND

THE Commonwealth Fund reported on January 19 that it had appropriated $1,841,332.46 in the year ending September 30, 1941, for purposes associated with "the welfare of mankind," in accordance with the wish of its founder, Mrs. Stephen V. Harkness.

In the past year the fund gave subsidies or consultant services in twenty-eight states in support of four main objectives: the encouragement of research and of good teaching in medical schools; the enrichment and extension of public health services to rural communities; the provision or improvement of hospital facilities and the standardization of hospital services in rural communities; and the strengthening of community facilities for mental health services.

Since most medical research undertakings aided by the fund are of long duration, only three of the thirty-eight pieces of research subsidized during the year were new. These were a clinical statistical review of a series of cases of essential hypertension, at the Columbia-Presbyterian Medical Center; a study of gynecological diagnostic methods, at Cornell University Medical School; and a study of cancer-producing substances from human tissues, at the University of Chicago.

At five schools of medicine departments of preventive medicine were subsidized; special provision was made during the year for the expansion of this department at Tulane. At one school, the University of Louisville, the department of psychiatry was subsidized. At four the fund helped to meet the cost of borderline services designed to link the departments of psychiatry and pediatrics. A grant was made to the Peter Bent Brigham Hospital in Boston to enlarge a psychiatric service forming part of the department of medicine. Seven promising young men already committed to teaching or research as a career were given fellowships for advanced medical study.

Aid for rural public health services was concentrated in four southern states: Tennessee, Mississippi, Alabama and Oklahoma. In the first of these the fund has been active for seventeen years. In four counties in Tennessee, three in Mississippi and one in Oklahoma local health departments have been built up to a point where they illustrate the value of adequate staffing and a planned program, and, with direct and indirect aid from the fund, the technical and administrative services of the state health departments have been strengthened. The state health laboratory of Oklahoma, for example, did 50 per cent. more work in the first six months of 1941 than in all of 1938. Progress in the control of tuberculosis by artificial pneumothorax and of gonorrhea by sulfonamide therapy marked the work of the county health departments to which the fund gives financial or technical assistance.

No new hospital award was made this year, but a community hospital at Pittsfield, Ill., was completed and one at Mt. Pleasant, Mich., was begun. The capacity of a hospital at Kingsport, Tenn., was doubled, the cost being divided between the fund and the community. The twelve hospitals already in service under this program were used almost to normal working capacity and their earned income rose faster than their operating expenses. At several hospitals visiting instructors from leading medical schools stimulated staff education through long informal clinical institutes.

Mrs. Edward S. Harkness is honorary president of the Commonwealth Fund. Malcolm P. Aldrich is president; the board of directors now includes Mr. Aldrich, Phil W. Bunnell, Samuel H. Fisher, George Welwood Murray, Dean Sage and William E. Stevenson.

STALIN PRIZES

In 1941, several outstanding Soviet scholars and mathematicians received Stalin Prizes for scientific contributions made during the last six or seven years.

The Stalin Prizes were established in honor of the sixtieth birthday of Joseph Stalin in 1939. They are divided into three classifications: 1st prize, 100,000 rubles; 2nd prize, 50,000 rubles; 3rd prize, 25,000 rubles.

The Soviet mathematicians receiving first prizes were:

Vinogradov, Ivan Metveyevich, member of the Academy of Science of the USSR, for his work published in 1937, entitled "A New Method in the Analytical Theory of Numbers."

Gelvich, Petr. Augustovich, Major General of Artillery, professor of the Artillery Academy of the Red Army, for his scientific works: "On Dispersion, Probability of Hits, and Mathematical Anticipation of the Number of Hits," published in 1934; "Theoretical Fundamentals for the Elaboration of Gunnery Rules," published in 1936; and "Firing at Rapidly Moving Targets," published in 1940.

Kapitza, Peter Leonidovich, member of the Academy of Science of the USSR, for his work "Turbodetander for Obtaining Low Temperatures and Its Application for Obtaining Liquid Air," published in 1939.

Muskhelishvili, Nikolai Ivanovich, member of the Academy of Science of the USSR, professor of the State University in the city of Tbilisi, for his work published in 1935, "Some Basic Problems in the Mathematical Theory of Elasticity."

Mathematicians receiving second prizes were:

Alikhanov, Abram Issaakovich, member correspondent of the Academy of Science of the USSR, and Alikhanian, Artem Issaakovich, scientific worker of the Physico-Technical Institute of the Academy of Science of the USSR, for their scientific work on radio published in 1936, 1938 and 1940.

Kholmogorov, Andrei Nicolayevich, member of the Academy of Science of the USSR, and Khinchin, Alexander Yakovlevich, member correspondent of the Academy of Science of the USSR, professors at the Moscow State University, for their scientific works on the theory of probability: "Asymptotic Laws of the Theory of Probability," published in 1936, "On Analytical Methods in the Theory of Probability," published in 1938, and "Limit Laws of the Sums of Independent Chance Quantities," published in 1938.

Pontriagin, Lev Semenovich, member correspondent of the Academy of Science of the USSR, professor of the Moscow State University, for his work published in 1938, "Topological Groups."

Sobolev, Sergei Ljvovich, member of the Academy of Science of the USSR, professor of the Moscow State University, for his works on the mathematical theory of elasticity: "Some Questions in the Theory of the Expansion of Vibrations," published in 1937, and "On the Theory of Non-Linear Hyperbolic Equations with Partial Derivatives," published in 1939.

THE INTER-AMERICA BUREAU OF THE NEW YORK ACADEMY OF MEDICINE

The New York Academy of Medicine, realizing the responsibility of North American physicians in the advancement and dissemination of knowledge of the medical sciences in the Western Hemisphere, has organized an Inter-America Division whose purpose is to cultivate friendship, understanding and sympathy with the medical men in other countries of the Americas.

It is pointed out that the present war has dimmed the light of the medical sciences in many, if not all, of the great medical teaching and research centers of Europe. Even were these centers still operating, access to them by North and South Americans alike is unattainable. As a result, an ever-increasing rapprochement is developing between the scientists of the Western Hemisphere. For the first time, perhaps, many of us are becoming acquainted, exchanging ideas, knowledge and culture.

To further these ends the Bureau of Clinical Information of the academy has made provisions to welcome medical visitors from the American countries and to extend to them the facilities it possesses for the pursuit of knowledge. A Spanish physician who can converse in Spanish, Portuguese and English will be available to the medical visitors from the Republics of Central and South America.

This bureau provides information regarding opportunities for post-graduate medical study in New York or other medical centers of the United States, and particularly publishes a *Daily Bulletin* of clinics, meetings, lectures, conferences, hospital rounds and other interesting medical activities in New York which are freely open to medical visitors.

At the academy itself, many lectures and conferences are held to which visiting physicians are welcomed. The library is one of the largest of its kind in the United States. Its files of American and foreign periodicals are very complete. A bibliographic and photostat service is available for visitors at the usual library rates. The library itself is open to the public every week day from 9 to 5 o'clock.

THE SHORTAGE OF TECHNICALLY TRAINED CHEMISTS

THE American Chemical Society has made public a survey of one hundred and eighteen colleges and twenty-nine chemical corporations and has issued a statement to the effect that present and impending shortages of technically trained men in the army of production threaten to hamper the war effort of the nation.

The survey was conducted by the Defense Committee of the society, consisting of Professor Roger Adams, head of the department of chemistry at the University of Illinois, *chairman;* Dr. James B. Conant, president of Harvard University; Professor Warren K. Lewis, Massachusetts Institute of Technology; Dr. Thomas Midgley, Jr., of Worthington, Ohio, vice-president of the Ethyl Gasoline Corporation; Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh; Dr. Robert E. Wilson, president of Pan American Petroleum and Transport Company, New York; and Dr. Charles L. Parsons, of Washington, D. C., secretary of the society.

It is reported by the committee that many chemical companies complained that production is falling off, and that future production is jeopardized by the withdrawal of trained chemists and chemical engineers from industry. An "appalling shortage" of trained individuals in chemistry and chemical engineering is shown by the colleges, which reported almost without exception that chemical or chemical engineering alumni are all employed and that current demands can not be supplied. Harvard University disclosed that the present shortage of trained chemists is the most serious in its experience.

That essential industry needs in 1942 from 2,000 to 3,000 more chemists and chemical engineers than will be graduated or are otherwise available, and "no one knows whence they are to come," was the situation brought out by a canvass of corporations representing a cross-section of the chemical industry. It is pointed out that "magnesium, aluminum, transparent plastics, rubber, explosives, medicinals and innumerable minor but essential supplies needed by the Army, Navy, Signal, Sanitary and Medical Corps, can be produced only under the guidance of trained engineering and chemical personnel."

The official statement, which is signed by Dr. Charles L. Parsons, secretary of the society, reads:

> The Army and Navy are deeply concerned. Investigations made by this organization prove that trained personnel to produce this material is lacking. Not only the finished product but also the raw material going into smokeless powder, rubber, etc., can be produced only under the active control of experienced chemists and chemical engineers. There is far greater immediate danger to the ultimate outcome of the war from shortages of such man power than there is from any lack of officers and men in the combat force. Without production of essential materials the war will be lost, since the combat forces can not exist without material.

SCIENTIFIC NOTES AND NEWS

THE John Scott Medals and Premiums of the City of Philadelphia were presented on February 13 at the midwinter meeting of the American Philosophical Society to Major Edwin H. Armstrong, professor of electrical engineering at Columbia University, for his work in frequency modulation in radio and to Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories, for his work on thiamin (vitamin B_1).

THE Edison Medal of the American Institute of Electrical Engineers was presented at the annual meeting to Dr. J. B. Whitehead, professor of electrical engineering at the Johns Hopkins University, and the Alfred Noble Prize for 1940–41 was presented to Robert F. Hays, Jr., of the research laboratories of the Sperry Gyroscope Company, for his paper entitled "Development of the Glow Switch."

THE fiftieth anniversary of the founding of the laboratory of psychology at Columbia University was celebrated at a dinner on February 12. Dr. J. McKeen Cattell, who established the laboratory, was in 1891 called from the University of Pennsylvania, where the first professorship of psychology at any university was held by him. Professor Albert T. Poffenberger presided and addresses were made by President Nicholas Murray Butler, Professor Edward L. Thorndike, Professor Robert S. Woodworth and Dr. Cattell.

AT a special meeting of the Mount Sinai Hospital, a volume was presented to Dr. Bernard Sutro Oppenheimer, in commemoration of his service to the hospital for thirty-seven years. The volume contains 106 papers, filling 869 pages on medical subjects written by specialists as a tribute to his contribution to the study of the heart and circulatory system during his period of service at Mount Sinai.

THE American Social Hygiene Association presented at a luncheon of the society on February 1 an honorary life membership to John D. Rockefeller, Jr., "for outstanding service to the social hygiene movement."

AT the Washington meeting of the Gorgas Memorial Institute of Tropical and Preventive Medicine, Inc., Colonel Joseph F. Siler, of Washington, D. C., was elected president. Other officers elected were: Dr. Bowman C. Crowell, Chicago, *vice-president;* Dr. Merritte W. Ireland, Washington, *secretary,* and A. M. Nevius, Washington, *treasurer.* Dr. Herbert C. Clark is director of the Gorgas Memorial Laboratory in Panama.

MEMBERS of the Institute of Food Technologists, residing in the New York metropolitan area, have organized a local chapter under the name of New York Society of Food Technologists. The officers are: *chairman,* J. H. Shrader; *vice-chairman,* D. K. Maveety; *secretary,* G. L. Montgomery; *treasurer,* R. F. Leight. The association will meet on the first Friday of March, May, October and December, at dinner sessions at the Faculty Club of New York University.

DR. BRADLEY M. DAVIS, professor of botany at the University of Michigan, retires this month with the title emeritus. He will continue to live in Ann Arbor.

DR. MAURICE H. SEEVERS, associate professor of pharmacology at the Medical School of the University of Wisconsin, has been appointed professor of pharmacology and chairman of the department at the Medical School of the University of Michigan.

JOSEPH MARIN, professor of civil engineering at the Illinois Institute of Technology, Chicago, has been appointed professor of engineering mechanics at the Pennsylvania State College. The appointment became effective on February 1.

DR. LOWELL J. REED, professor of biostatistics and dean of the Johns Hopkins University School of Hygiene and Public Health, has been appointed chairman of a national commission on vital records which has been established at the request of the Association of State Health Executives and the American Association of Registration Executives as a special committee of the Health and Medical Committee of the Office of Defense Health and Welfare Services.

HERBERT G. DEIGNAN has been advanced to the position of associate curator in the Division of Birds of the United States National Museum. Dr. David H. Johnson, who has been associated with the Museum of Vertebrate Zoology at the University of California as graduate student and assistant, has been appointed assistant curator in the Division of Mammals.

DR. JOHANNES S. BUCK has resigned his position with Burroughs Wellcome and Company, Tuckahoe, N. Y., to become associate director of the Research Laboratory of the Winthrop Chemical Company, at Rensselaer, N. Y.

ALAN MORRIS, chief metallurgist of the Bridgeport Brass Company, Connecticut, has been appointed director of research.

DR. CHARLES E. OLMSTED, of the department of botany of the University of Chicago, has been made botanical editor of *Ecology.* He succeeds Professor Francis Ramaley, of the University of Colorado. Professor Thomas Park, of the Hull Zoological Laboratory of the University of Chicago, remains editor for zoology.

DR. WILLIAM BEEBE, of the New York Zoological Society, and his associates have sailed for Venezuela. They plan to make a six-months study of conditions in the jungle.

DR. STANHOPE BAYNE-JONES, professor of bacteriology, formerly dean of the Yale School of Medicine, a Lieutenant Colonel in the Reserve Corps, has been called to active duty and assigned to the office of the Surgeon General of the U. S. Army in the Division of Preventive Medicine and Epidemiology. On leave of absence, he will continue as director of the Jane Coffin Childs Memorial Fund for Medical Research, which was established at Yale in 1937 and is primarily concerned with research in cancer. Dr. Ralph G. Meader, assistant professor of anatomy, has been appointed assistant to the director of the fund and will be in charge of the office during the absence of Dr. Bayne-Jones.

THE Board of Pharmacy of the State of New Jersey, with the approval of Governor Edison, has complied with the request of the Civilian Supply Division of the War Production Board to release Dr. Robert P. Fischelis, secretary and chief chemist of the New Jersey Board of Pharmacy and member of the New Jersey State Board of Health, for part-time service as chief of the Section of Medical and Health Supplies of the Civilian Supply Division of the War Production Board. Dr. Fischelis will organize a staff of specialists and consultants in the field of hospital, medical and drug supplies at the Washington office of the War Production Board.

THE president of the Western Society of Soil Science, Dr. Lawrence C. Wheeting, of the State College of Washington, was called to active duty with the United States Army on February 11. Those planning to present papers at the June meeting of the society, which will be held in connection with the meetings of the American Association for the Advancement of Science, Western Division, at Salt Lake City, are requested to communicate with the vice-president, Dr. T. L. Martin, Brigham Young University, Provo, Utah; or with Dr. W. P. Martin, secretary of the University of Arizona, Tucson.

DR. ROGER ADAMS, professor of chemistry, University of Illinois, delivered the fifth Harvey Society Lecture of the current series at the New York Academy of Medicine on February 19. Dr. Adams spoke on "Marijuana."

DR. HARDY CROSS, chairman of the department of civil engineering of Yale University, delivered three addresses at Iowa State College on February 16 and 17. The titles will be "The Column Analogy and Moment Distribution in Relationship to Structural Engineering," "What is Civil Engineering?" and "Epistemology of Engineering." Sponsors for the lectures are, respectively, the Research Council of the college, the Iowa Section of the American Society of Civil Engineers and the chapter of Sigma Xi.

DR. MAURICE C. PINCOFFS, professor of medicine at the School of Medicine and College of Physicians and Surgeons of the University of Maryland, delivered the Henry Sewall Memorial Lecture on February 3 during the annual meeting of the Medical Society of the City and County of Denver. His subject was "Epidural Abscess."

THE Section of Physics and Chemistry of the New York Academy of Sciences will hold on February 27 and 28, at the American Museum of Natural History, a conference on "Physics of the Solid State."

The Journal of Animal Science has been established by the American Society of Animal Production. It will be issued quarterly (February, May, August and November). The journal replaces the Annual Proceedings which have been issued by the society for the past thirty-three years. It will be edited by a board which represents the following branches of work in animal husbandry: Genetics, nutrition, physiology, general livestock, meats, wool, dairy cattle and extension. Ralph W. Phillips is chairman. The business manager of the journal is Dr. A. D. Weber, Kansas State College, Manhattan, Kansas.

THE University of Michigan Extension Service and the Engineering Society of Detroit dedicated on January 28 a new building in the city of Detroit, to be used jointly by the two institutions and to be known as the Rackham Educational Memorial. Funds for the building, which was erected at a cost of $2,000,000, were given to the university and to the engineering society by the Horace H. Rackham and Mary A. Rackham Fund and Mary A. Rackham.

PLANS for the erection of a new radio tube manufacturing plant at Manheim Township, Lancaster, Pa., have been announced by the RCA Manufacturing Company. A tract of land from the Frank McGrann properties adjacent to the Pennsylvania Railroad main line has been purchased by the company. The work, which will be concerned with special purpose radio and electronic tubes, is being undertaken in cooperation with the U. S. Navy. Ground for the main building, which will occupy 326,000 square feet of space, will be broken early in March, and it is expected that the building will be completed by about September 1.

A REPOSITORY for charts and important records of the U. S. Coast and Geodetic Survey is being established as a war-time precautionary measure. The exact location of the repository is not disclosed, but it is understood to be somewhere in the Middle West. An official of the survey was recently detailed to complete arrangements. Discussing this step to protect vitally important nautical and aeronautical charts and other records, Rear Admiral L. O. Colbert, director of the survey, said: "A black and white copy of each of the more than 1,000 nautical and aeronautical charts published by the survey will be sent to the repository. This will enable reproduction by photographic methods in the event that the plates from which they are now printed in the Washington office are lost or damaged. Microfilm copies of valuable seismological records are also being sent to the repository and it is likely that other material of importance will follow."

A SPECIAL fund has been placed in the charge of the Committee on Scientific Research of the American Medical Association to support cardiologic research by young physicians in medical practice. Inquiries may be addressed to the committee, 535 North Dearborn Street, Chicago.

A GRANT of $10,000 has been made by the Carnegie Corporation of New York, in support of the research program of the Clinic of Child Development at the School of Medicine of Yale University. The clinic, which was founded in 1911 by Dr. Arnold Gesell, its present director, is investigating the mental growth of normal infants and devising clinical methods for the early diagnosis of developmental defects and deviations.

A GIFT of £2,000 from the American College of Surgeons has been received by the Royal College of Surgeons of England to help towards its restoration. The gift was offered immediately after the damage by enemy action was described at the recent congress of the American College by Surgeon Rear-Admiral Gordon-Taylor, who attended the congress as the representative of the Royal Navy and the Royal College of Surgeons. The American College has also set aside an additional sum to cover the cost of an appeal to the surgeons of the United States for contributions to a fund to assist still further in the restoration of the English college.

DISCUSSION

A TWELVE-MONTH COLLEGE YEAR: AN ALL-OUT PROGRAM

AFTER World War I, the author published an article, "A Twelve-Month College Year,"[1] in the interest of intensive instruction and the promotion of economy. It is now more important than ever that we follow these principles.

ECONOMIES. UTILITY OF EQUIPMENT AND TIME

We have an enormous investment in schools, colleges and universities, many of which are utilized only seventy-five per cent. of the year. The business world considers efficiency and economy important. Why not use educational facilities the year 'round and operate during the summer months when light and fuel costs are at a minimum?

Some may think that the cost of such a plan would be prohibitive. With present limited endowment incomes and economic resources in education, institutions of higher learning may not be able to operate the entire year. However, with less time loss in education, industry might be so impressed with the service rendered by educational institutions as materially to increase its financial assistance. State legislatures might increase appropriations, and the Federal Government might partially subsidize higher education.

EARLIER EARNING POWER

With a quarter system (four terms of twelve weeks each) students might enter colleges and universities on October 1, January 1, April 1 and July 1. October 1 seems to be the traditional opening date for the college year. Certainly June graduates of high schools would not have to wait until the fall to enter an institution of higher learning. If the quarter system does not appeal, three trimesters of sixteen weeks each can be scheduled. In any event, there are four weeks for vacations out of the fifty-two and these could be distributed in various ways.

Students, instead of losing time during long vacations now in vogue, could obtain a bachelor's degree in twelve quarters or in eight trimesters. What this means in the present emergency has already been stressed by government and by educators. Most college students could obtain their degrees before they are twenty-one. Whether graduates are to serve in industry or are to enter military service, intensive training makes them available at least one year earlier than the traditional system.

STUDENT FINANCES

Not all students could afford to attend college twelve months in a year. Many of them work during summer months to earn enough for tuition. This difficulty could be overcome in a number of ways: (1) With the repetition of courses each quarter or trimester or in alternate quarters or trimesters students who must work to obtain an education could remain out of college for a period during which courses which they have just completed are repeated. Having obtained funds they might take up where they left off. Students could go out at various times of the year and not be dependent on a summer period during which there is a dearth of work and a superabundance of student labor. (2) Establishing a cooperative system would not only help students to finance their education, but it would furnish a regular supply of trained workers for industry and for the nation. Assuming that each undergraduate course is offered each quarter or each trimester, students could be sent out in relays to obtain practical experience in industry, in teaching and in government service. With a definite number going out each period of the year, industry would have a constant supply and could at the same time appraise desirable individuals who might be employed permanently upon graduating. The government in connection with its ROTC and perhaps similar units for the Navy and aviation could also have students in training, in relays, and be well equipped with a reserve group in time of emergency. The relay system of cooperation with industry is not new. It is in effect in a small number of institutions. The relay system in connection with government service does not exist to the author's knowledge. Certainly if the idea were generally applied, we could continuously afford educational, industrial and Federal fields a supply of individuals for training, and, upon graduation, give the nation a regular supply of skilled leaders. Also, let us not forget that students who can afford to attend college continuously will have their full earning or serving power at the end of two and two thirds or three years in the trimester and quarter systems respectively.

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[1] *School and Society*, 12: 291, 80–82, July 24, 1920.

FACULTY SALARIES AND SCHEDULES

At present most teachers are paid only nine or ten months of the year. It is a tradition that the summer period is necessary for study, research or travel. How many teachers utilize the period for any of these purposes? Many of them necessarily work during the summer to increase incomes.

Assuming a twelve-month college year with a regular salary payment for each of the twelve months, the ambitious teacher could still be free during a quarter, trimester or even longer period by making the necessary arrangements and could probably have a much greater variety of study and research at his command than is possible during the summer term. Teachers might even gain practical experience in relays like the students, or they might plan work under great leaders who are not available during summer sessions. By working continuously over an appreciable number of years, an entire year might be available for travel or study. In other words, vacation or study periods could be planned or selected so as best to serve the individual's wants.

What about the traditional summer session? As not all schools are likely to subscribe to a plan like the one which has been proposed, short summer terms to meet state-teacher requirements and the wants of those who have been in the habit of taking summer courses could still be made available.

A CRITICAL PERIOD

A real "all-out" program requires full and immediate cooperation from every man, woman and child. Why not start the "twelve-month college year" now, even if parents and teachers have to make a monetary sacrifice, temporarily? Eventually industry, the state and the nation will make the sacrifice unnecessary.

ALEXANDER SILVERMAN

UNIVERSITY OF PITTSBURGH

MEAN SEA LEVEL AND SAND MOVEMENT: A REPLY[1]

SPECULATIVE hypotheses which overlook factual evidence are luxuries which might well be dispensed with during the war, particularly where conclusions might lead to errors of judgment in military construction. A serious case of this nature appeared recently in this journal[2] and was the less excusable because its writer had been informed of the facts. In this article Leypoldt attempted to show that observations by U. S. Grant and by the writers relative to seasonal offshore shifting of sand in winter and onshore shift in summer have been based on erroneous interpretations, and that actually the sand is shifted along the shores of bays due to changing currents piling up at one end of each bay during one season and at the other end during another season. Leypoldt gives the impression that these shifts of the sand are well known and that the out- and in-movement of sand is nothing but an unwarranted assumption.

These arbitrary statements by Leypoldt will be a surprise to every one who has studied the California beaches either from a scientific or engineering point of view. According to Leypoldt, the sand beaches should be as wide on the average in summer as in winter, but the wide zones should be present at different places. This can be said to be absolutely contrary to fact. The writers have made over 50,000 soundings and observations on the width of beaches at La Jolla and elsewhere along the California coast during the past nine years. Short-interval observations have been made for the past four years along the entire length of the beach south of the Scripps Institution of Oceanography at La Jolla and for over a year LaFond has measured the depths along the three open ocean piers in the San Diego area at frequent intervals. Grant and his students have made seasonal measurements of beach profiles at a number of places along the coast near Los Angeles. Also the Los Angeles County engineers have measured profiles off the beaches in Santa Monica Bay at different seasons. The results have been remarkably similar. In nearly all cases the sand level has shown a decrease along the shore during winter and an increase outside. Numerous small beaches in coves of rocky headlands are completely washed out during the first winter storms and do not return until there has been a long period of small waves. In some cases the beach is removed and rebuilt several times during a season, provided there are long calm periods alternating between storms.

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[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 155.

[2] Harry Leypoldt, SCIENCE, 94: 2452, 607–609, 1941.

On the other hand, there is much evidence of temporary shifting of sand along the beaches and there are times when cutting at one part of a beach is accompanied by fill along another portion. The records obtained from the beach extending south of Scripps Institution show cases of this nature and the observation of currents at the end of the pier show the reason for the shift of the sand. However, these lateral shifts are on the whole subordinate to the outward and inward movements of the sand as evident from the shoaling and deepening of water recorded several hundred feet from shore.

Leypoldt appears to be disturbed by the idea that oscillating wave motions are accompanied by shifting of sand both toward the land and toward the sea. The study of rip currents[3] gave some data in this regard. Also the study of the effects of different kinds of waves[4] in relation to the shifting revealed that large waves of long period shift sand seaward most effectively, whereas small waves of small amplitude shift sand towards the land.

Leypoldt's hypotheses as to the cause of seasonal fluctuation in sea-level heights are as ungrounded as are those concerning sand movements. He states, "Sea-level heights are functions of rainfall in the locality, together with river discharge and other methods of ground-water return, and water removal for rainfall." Observations from the tide staff at La Jolla show that sea level here is usually highest during the months of least rainfall, when the Southern California rivers are dry, and when the water has its highest salinity. The more plausible explanation of sea-level fluctuation is based upon the fluctuations in water temperatures.[5]

Other statements by Leypoldt, such as "When sea level is high along the Pacific coast of the United States it is low along the South American coast, necessitating an interchange of water between the hemispheres," are made without giving any data whatsoever, so that one wonders if they are not also based on some of Leypoldt's hypothetical hunches. It is to be hoped that in the future Mr. Leypoldt will make some attempt to investigate the facts before he lets these wild ideas loose on the scientific public.

FRANCIS P. SHEPARD
UNIVERSITY OF ILLINOIS

EUGENE C. LAFOND
SCRIPPS INSTITUTION OF OCEANOGRAPHY

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[3] F. P. Shepard, K. O. Emery and E. C. LaFond, *Jour. Geol.*, 49: 337–369, 1941.

[4] E. C. LaFond, *Proc. 6th Pacific Science Congress*, II: 795–799, 1939.

[5] E. C. LaFond, *Jour. Marine Research*, 2: 1, 17–29, 1939.

ON TOAD AND FROG ABUNDANCE AFTER HEAVY RAINFALL[1]

GUNTER'S observation on the exceptional abundance of young toads after a season of very heavy rain in southern Texas[2] prompts me to record my observations on the same type of phenomenon in Oklahoma during the same year. A total of 29.02 inches of rain was recorded at Norman, Oklahoma, during the first half of 1941, of which 25.22 inches came between April 1 and June 30. There were 12.02 inches in June alone. Comparable amounts were recorded in many other parts of the state. The extensive flooding formed temporary pools which did not completely evaporate in some regions till mid-summer. From early in April till near the end of June, extensive choruses of Amphibian voices could be heard almost any night and often during the day immediately after a rain. There was a greater opportunity for all forms to breed than had occurred here for many years.

The various species reacted differently, however. The flooding produced many more young than usual of: (1) *Bufo cognatus* Say—literally millions emerged from pools from early May to early June; (2) *Pseudacris streckeri* Wright and Wright; (3) *Pseudacris clarkii* Baird—choruses were so heavy as to be deafening at times, hundreds of thousands of young emerged; (4) *Microhyla olivacea* (Hallowell); (5) *Scaphiopus bombifrons* Cope; (6) *S. hurterii* Strecker; and (7) *Rana sphenocephala* (Cope). I could find no evidence that the successful reproduction of the following had been materially increased: (1) *Bufo a. americanus;* (2) *B. w. woodhousii* Girard; (3) *Acris crepitans* Baird; (4) *Hyla v. versicolor* Le Conte; and (5) *Rana catesbeiana* Shaw. All the above pertains to the region of Norman, Cleveland County.

In southeastern Oklahoma, neither *B. a. americanus, B. w. fowleri, Rana clamitans* Latreille, *R. catesbeiana* nor *R. a. areolata* Baird and Girard reproduced successfully in exceptionally great numbers, but *Pseudacris triseriata* (Wied), *Microhyla olivacea* and *Rana sphenocephala* did so.

It should be recorded also that autoists traveling U. S. Highway 66 between Oklahoma City and central New Mexico reported "thousands of young toads" on the road at night in June. Many similar reports from southwestern Oklahoma lead me to believe that *B. compactilis* was very productive, since this is the toad in that region most likely to frequent roadways in numbers.

The differential reactions of these groups of species is in complete accord with the view that some species are specifically adjusted to a grassland habitat in their breeding activities, whereas others are not. For a fuller expression of these ideas see the following papers by the author.[3]

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[1] Contribution from the Zoological Laboratory of the University of Oklahoma.

[2] *Copeia*, 4: 266, 1941.

ARTHUR N. BRAGG

UNIVERSITY OF OKLAHOMA

CALENDAR REFORM AND THE NATIONAL ACADEMY OF SCIENCES

MANY persons think that our present calendar has certain defects which could easily be remedied. The chief ones are (1) that a particular day of the month occurs in successive years on a different day of the week, making necessary a wholly new calendar each year, and (2) that the length of the months is not uniform but varies from 28 to 31 days. These two defects make the arrangement of schedules for industry and education difficult and temporary only.

Defect (1) could be remedied in a very simple way. The solar year, as recognized in our present calendar, consists of 365 days, or in leap years of 366 days. Neither period is divisible exactly into 7-day weeks. Fifty-two 7-day weeks make 364 days. If the 365th day is not included in one of these 52 weeks, but is considered an *extra Saturday*, or simply a *Year day*, a holiday, the new year will begin on Sunday always. The 366th day of leap years can be used in a similar way as an *extra Saturday*, or *Leap year day*, a holiday in the middle of the year, without disturbing the occurrence of a particular day of the month always on the same day of the week.

Two different proposals for calendar reform which have been widely discussed in recent years remedy defect (1) in this same simple and sensible way. But they differ in the way they deal with defect (2).

A proposed 13-month calendar would have each month consist of exactly 4 weeks. An objection which has proved fatal to this proposal in popular esteem is that the year would not be divisible by months into quarters and the familiar twelve months would have to be abandoned.

A less radical proposal is known as the World Calendar of twelve months and four equal quarters. This retains the familiar month names but adjusts their lengths so as to make them as nearly equal as possible. Each quarter begins on Sunday and ends on Saturday. It contains 91 days. There are 30 days in each month except the first month of the quarter, which by reason of having a fifth (the initial) Sunday has 31 days. The number of week days is the same in every month, 26.

From a wish to ascertain the opinion of a body of eminent scientists upon the desirability and practicability of the proposed World Cadendar, an informal post-card questionnaire was recently sent to each member of the National Academy of Sciences. Replies were received from 168 members, more than half of the entire membership.

One question was worded, *"Do you consider the adoption of a revised World Calendar of 12 months and equal quarters, as outlined by the World Calendar Association, to be desirable?"* The answers were *"Yes,"* 128 (76 per cent.), *"No,"* 17 (10 per cent.), *"Undecided,"* 23 (14 per cent.).

Another question was worded, *"Would you consider it practicable for the United States to begin the use of such a calendar on January 1, 1945* [which will be a Sunday in our present calendar] *in collaboration with other governments?"*

The answers of the 128 who favor the World Calender were *"Yes,"* 74 (58 per cent.), *"No,"* unless the war ends soon enough, 54 (42 per cent.).

There can accordingly be no doubt about what would happen in calendar reform, if the scientists had their way.

W. E. CASTLE

BERKELEY, CALIF.

FISHERIES LITERATURE FOR CHINA

AN official of the Chinese Government with its capital now at Chungking has asked that there be secured for him whatever fisheries literature is available in order that some start may be made on the rehabilitation of Chinese fisheries after the war.

Such assistance will be a practical and direct way of showing our sympathy with the Chinese. It speaks volumes for their courage and confidence that such preparations should be under way.

He would be more than glad to receive any form of fisheries literature whether it deals with life history, systematics or technology which any reader of this notice may be able to spare for transmittal at such time as communications are re-established.

These should be sent to School of Fisheries, University of Washington, Seattle, Washington, and marked plainly as intended for Ti Chow, Chungking.

W. F. THOMPSON,
Director

SPECIAL CORRESPONDENCE

ANALYSIS OF POST-WAR PROBLEMS AND PROCEDURES

AFTER winning the first World War, the Allies lost the peace because of the inability of statesmen and public opinion to understand the dependence of national security on world order and the dependence of world order upon truly workable international relations. Assuming the defeat of Hitlerism, how may the mistakes of the last twenty-two years be avoided by the victorious nations? Many groups both in and out of government circles are working on aspects of this problem.

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[3] *Amer. Nat.*, 74: 322, 1940; *Amer. Midl. Nat.*, 24: 306–335, 1940; *Wasmann Collector*, 4: 6, 1940; *Turtox News*, 19: 10, 1941; *Great Basin Nat.*, 2: 109, 1941; and *Turtox News*, 20: 12, 1942.

Because of the importance of science and specialized learning for problems of post-war adjustment and the need for representatives of the various disciplines better to understand each other, the American Academy of Arts and Sciences is devoting its regular monthly meetings, November through May, to the subject of "Analysis of Post-War Problems and Procedures." The meetings are held at the Boston house of the academy under the chairmanship of its president, Harlow Shapley. The academy has approximately 800 members elected from a wide variety of professional fields. It especially represents competences in the natural and social sciences and in engineering and affairs.

Alfred North Whitehead, professor emeritus of philosophy, Harvard University, opened the series in November with a paper entitled, "Statesmanship and Specialized Learning."

The meeting on December 10th was concerned with problems of communication and transportation in a post-war world. Igor I. Sikorsky, engineering manager of United Aircraft Manufacturing Corporation, spoke on "The Air Transportation of the Future." Walter S. Lemmon, president of the World Wide Broadcasting Foundation, spoke on "Radio as a New Force in the Post-War World." A forum on December 15th followed this meeting and was led by Douglas H. Schneider, program manager of Station WRUL, and Joseph S. Newell, professor of aeronautical structural engineering at the Massachusetts Institute of Technology.

The meeting on January 14th was addressed by Zechariah Chafee, Jr., Langdell professor of law at Harvard University, on the subject of "International Utopias."

The February meeting will be in the hands of geographers. Professor Clarence Jones, of Clark University, will consider the economic geography of Latin America in relation to the war and to post-war problems, and Professor Samuel Van Valkenburg, also of the Clark geography department, will discuss the significance of the Netherlands East Indies in the present conflict.

At the March meeting anthropologists and social psychologists will consider ways in which these sciences may be of help in implementing the ideals of post-war democracy.

Hudson Hoagland,
Recording Secretary
American Academy of Arts and Sciences

THE JAMES RIVER DRAINAGE AREA

There is now being compiled, under the chairmanship of Dr. Marcellus H. Stow, professor of geology at Washington and Lee University and president-elect of the Virginia Academy of Science, a monograph on the James River drainage area. The river, of so much romantic appeal, thus forms the unifying feature around which will be correlated an imposing body of scientific, sociological and historical research. Of Virginia's 100 counties, forty-two are either wholly or in part within the James River drainage basin. All branches of science are represented within the area and most of the universities, colleges and research institutions of the state are there located.

Dr. Stow will write the editorial preface of the monograph, to be called "The James River—Past, Present, Future," and will also cooperate with Joseph K. Roberts, professor of geology at the University of Virginia, and E. C. H. Lammers, assistant professor of geology at Washington and Lee, in preparing the chapter on "Geology." Other chapters and those who have accepted invitations to write them are as follows: "The James River Region as a Thoroughfare before the Coming of White Men," Austin H. Clark, curator of echinoderms, Smithsonian Institution; "Development of Transportation in the James River Area," L. S. Evans, assistant to vice-president, Chesapeake and Ohio Railway, and John J. Forrer, maintenance engineer, Virginia Department of Highways; "Recreation in the James River Region," Robert F. Nelson, public relations counsel, Virginia State Chamber of Commerce; "Agriculture," A. W. Drinkard, Jr., director, Virginia Agricultural Experiment Station; "Astronomy, Mathematics, Physics," T. McN. Simpson, dean of Randolph-Macon College; "Botany," Ivey F. Lewis, dean of the University of Virginia; "Entomology," G. T. French, entomologist, Virginia Department of Agriculture; "Fish and Marine Invertebrates," Donald Davis, professor of biology, College of William and Mary, C. L. Newcombe, professor of biology, College of William and Mary, and Theodore Fearnow, wildlife technician, U. S. Forest Service; "Reptiles and Amphibians," Paul Burch, professor of biology, Radford State Teachers College, and Robert P. Carroll, associate professor of biology, Virginia Military Institute; "Birds," James J. Murray, Lexington; "Mammals," Talbott E. Clarke, wildlife technician, U. S. Forest Service; "Inorganic Chemistry," William G. Guy, professor of chemistry, College of William and Mary; "Education and Psychology," Dabney S. Lancaster, state superintendent of public instruction; "Engineering," Carter Hanes, associate professor of engineering, Virginia Military Institute; "Forestry," Chapin Jones, professor of forestry, University of Virginia; "Medical Sciences," H. J. Warthen, Richmond; "Industry in the James River Area," L. S. Evans, assistant to vice-president, Chesapeake and Ohio Railway; and "Conservation of Natural Resources," Henry B. Ward, emeritus professor of zoology, University of Illinois. The chapter on "Organic Chemistry" has not yet been assigned.

The monograph, to be approximately 600 pages, is expected to be published by the Virginia Academy of Science by the fall of 1942. Obviously it will be an incomplete work, but it should call attention to needed fields of investigation in the region and thereby serve as a stimulus for a serious long-term statewide undertaking to which scientists and others of various interests can contribute. It might also prove to be an example of what might be done elsewhere.

Sidney S. Negus

Medical College of Virginia

SCIENTIFIC BOOKS

BOOKS ON GEOLOGY

New Editions of Standard Texts

Outlines of Physical Geology. By Chester R. Longwell, Adolph Knopf and Richard F. Flint. Second edition. 381 + ix pages. 281 figs. + frontispiece. John Wiley and Sons. 1941. $2.75.

Outlines of Historical Geology. By Charles Schuchert and Carl O. Dunbar. Fourth edition. 291 + ix pages. 176 figs., 6 plates + frontispiece. John Wiley and Sons. 1941. $2.50.

Outlines of Geology. By Longwell, Knopf, Flint, Schuchert and Dunbar. Second edition. A combination of the two preceding books, bound into a single volume. John Wiley and Sons. 1941. $4.00.

Introduction to Geology. By E. B. Branson and W. A. Tarr. Second edition. 482 + ix pages. 447 figs. McGraw-Hill Book Company. 1941. $3.75.

Introduction to Physical Geology. By William J. Miller. Fourth edition. 465 + xi pages. 397 figs. + frontispiece. D. Van Nostrand Company. 1941. $3.25.

Field Geology. By Frederic H. Lahee. Fourth edition. 851 + xxxii pages. 589 figs., 1 plate. McGraw-Hill Book Company. 1941. $5.00.

Here is abundant evidence of the vitality of geological science and the eagerness of textbook writers in this field to provide the student and field worker with the best possible tools for their work. Advances in method and doctrine, chiefly the result of emphasis upon quantitative as contrasted with qualitative analysis of geological problems, have been numerous in the last few years and many of the repercussions of this progress are reflected in these new editions of standard treatises. Improved pedagogical techniques are also apparent, as well as a considerable improvement in illustrative material, involving both the frequent use of aerial photographs and more skilful drafting of block diagrams and other line drawings.

The "Outlines" of physical and historical geology, by the Yale geologists and paleontologists, contain many significant changes from the preceding editions published respectively seven and four years ago. As they now stand they are even better suited than before to meet the needs of the interested layman who wants an introduction to earth science without formal instruction, and at the same time they will serve even more satisfactorily as textbooks for elementary courses on the college level. The number of technical terms has been reduced to what is now in all probability the irreducible minimum. Considerable attention is paid to the numerous practical aspects of geology, including its application in engineering projects such as dams, aqueducts and tunnels. In presenting the history of the earth and its inhabitants, eras rather than periods are used as the units for treatment, and the record of changes in the physical features of the earth is presented in its entirety before the pageant of life is considered.

The "Branson and Tarr" has similarly been streamlined by simplification of treatment and terms so that the new edition is even more suitable than the old for instruction of students who do not plan to become geologists, while at the same time it will serve admirably as the basis for the first steps in the training of professional workers in the field of earth science. Improvements in the illustrations are especially notable, both because of additions and substitutions and as a result of better paper and printing.

In comparison with the earlier third edition of Miller's textbook, the fourth edition, now in hand, embodies numerous minor changes, but the general style and method of treatment remain the same. Many improvements in the illustrations are apparent and the statistical material pertaining to economic geology has been brought up to date.

The new edition of Lahee's widely used manual, when compared with the earlier edition published in 1931, provides a very accurate measure of the progress of geology during the decade. New material on such subjects as mass movements, varves, lensing strata, permeability of sedimentary rocks, petrofabrics, electrical logging, subsurface correlation by radioactivity and airplane mapping, reflects the results of intensive research in field and laboratory and the increased use of various geophysical methods for geologic exploration. The wealth of excellent diagrams and photographs, the systematic organization of the text, and the concise, lucid style make this book an unusually valuable tool for the professional geologist as well as a very effective text for the student.

Earth Sciences. By J. HARLEN BRETZ. 260 + x pages. 129 figures. John Wiley and Sons. 1940. $1.75.

THIS compact book is one of a series edited by Dr. Gerald Wendt comprising material for a survey course for college students covering the natural sciences. Its author is professor of geology in the University of Chicago, where he has had an unusual opportunity to experiment along the lines of presenting science as an integral part of a liberal education rather than merely as preparation for a professional career. Its subject-matter is that of the three closely related fields of meteorology, oceanography and geology, the sciences that deal with the various natural elements in our physical environment.

Dr. Bretz has selected his topics and discussed them with his readers with rare skill, successfully avoiding a superficial smattering of descriptive knowledge on the one hand and a merely verbal lightening of the burden of technicalities on the other. The chatty informality of his style makes "easy reading." The well-phrased and often sharply pointed questions, sifted throughout the pages as footnotes or in the body of the text, must stimulate even sluggish minds and are well designed to keep the reader intellectually alert. Most important of all, however, is the artistry with which he lays the groundwork for an appreciation of the method of scientific approach and of its trustworthiness.

Outlines of Structural Geology. By E. SHERBON HILLS. 172 + x pages. 105 figures, 4 plates. Nordeman Publishing Company. New York. 1940. $2.25.

THE concisely written text and expertly selected diagrams of this slender volume combine to make it a most valuable tool for both the student of structural geology and the well-trained worker in this field. The numerous definitions of terms and the rather full synonymy are especially helpful because of the various usages regarding nomenclature in the description of many types of geologic structure. Many a geologist will value it as a reference work to be kept close at hand while compiling reports and preparing papers for publication.

Dr. Hills is lecturer in geology in the University of Melbourne. He has read widely and draws his illustrations from North American geology as often as from that of Europe. He makes good use of many geophysical data available from research in high-pressure laboratories in the United States as late as 1939. The handicap resulting from the geographical remoteness of Australia has been completely overcome.

Beginning with a survey of primary structures of sedimentary rocks and non-diastrophic deformation, Dr. Hills proceeds with a consideration of the mechanical principles of rock deformation. The next chapter deals with the major structural features of the earth's crust and then come chapters on folds and faults. Finally, after a survey of the structures of igneous rocks in which the work of Cloos and his collaborators is stressed, there is a brief but inclusive chapter on petrofabric analysis.

Geology of Coal. By OTTO STUTZER. Translated and revised by Adolph C. Noé. 461 + xiii pages. 198 figures. University of Chicago Press. 1940. $5.00.

THIS is much more than a mere rendering into English of a classic monograph in German. Dr. Stutzer's "Kohle," published in 1914, served as the nucleus of the material translated by Professor Noé, but considerable portions of the book are translations of texts supplied subsequently by Dr. Stutzer or of material published more recently by him. To this is added a modicum of original matter based on Professor Noé's own studies under the auspices of the geological surveys of Illinois and Kentucky and as geologist of the Allen and Garcia Commission to Soviet Russia, as well as his research as professor of paleobotany at the University of Chicago. In the preparation of the book for publication after Professor Noé's death, Dr. Gilbert H. Cady, of the Illinois Geological Survey, rendered valuable service.

The book deals extensively with the nature of coal, its mode of formation, its peculiarities of variation, the thickness and extent of coal beds, the nature of the associated rocks, the character of irregularities of various sorts that affect the ease of recovery of coal in mining operations, the methods of study by means of thin sections and chemical analysis, and the floras associated with coal of various localities and ages. It includes little data pertaining to statistics of coal resources, production or reserves.

Students in university courses dealing with the geology of fuels will find this a most helpful text. Geologists, mining engineers and other persons concerned with the coal industry will gain much valuable information from it and will find its extensive bibliographies particularly useful.

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MOLECULAR SPECTRA

The Identification of Molecular Spectra. By R. W. B. Pearse and A. G. Gaydon. 221 + viii pp., 8 plates. New York: John Wiley and Sons, Inc. 1941. $8.00.

The essential features of this book are (1) a "Table of Persistent Band Heads" arranged in order of wavelength, (2) a compilation entitled "Individual Band Systems" containing rather complete lists of band heads arranged according to molecules. In addition there are very helpful brief discussions on the purpose and method of use of the tables and on the spectroscopic sources from which band spectra are obtained. There are a useful appendix and an excellent set of plates showing reproductions of important band spectra. The book fills an important gap for research workers in the field of molecular spectra, who hitherto have had no systematic guide for the rapid identification of known bands. It may also help to make possible the use of band spectra in spectrochemical analysis.

The tables cover the range $\lambda 2,000$–10,000. The attempt has been made to include all diatomic spectra and some of the simpler polyatomic spectra, but spectra of solutions, liquids and solids are excluded. In the Table of Persistent Heads, bands "of particularly frequent occurrence as impurities" are marked with asterisks. Here one might disagree somewhat with the assignment of asterisks, and also with the choice of spectra included in and excluded from the table. The strong short wave-length SO_2 absorption bands near $\lambda 2,200$, which are not included, ought to be included and with an asterisk; the writer knows of at least three instances where these bands have turned up very deceptively as impurities, in the absorption spectra of such diverse substances as ICl, HF and AgBr. However, the table as it stands will be exceedingly useful in identifying bands, particularly since it gives an indication of the probable intensity of occurrence of each band in each of a variety of different types of sources.

The section on "Individual Band Systems," which forms the heart of the volume, gives a very helpful survey of the spectra of each molecule listed. Selected references are given, not necessarily to the latest work, but particularly to articles containing reproductions. Methods of excitation, and classification of the electronic states involved, when known, are also given. No attempt is made to give data or references on rotational structures of bands. Multiple band heads, when present, are, however, usually listed. For most molecules, all known bands are listed; for some, only the strongest bands; in a few cases, notably the halogens, where the number of bands is large, the list is omitted. A rather casual sampling indicates that there are a number of omissions in the diatomic list. Thus, four systems of AgI and AgBr bands[1] and one system of CuCl bands[2] are unmentioned, though certain SH^+ bands published slightly later[3] in the same journal are included. (Some references up to 1940 are included.) The red system of Br_2 is not mentioned, although the reference in which it was published[4] is given. The occurrence of BiCl bands in emission,[5] and the latest work on the $\lambda 2314$ C_2 band, with a photograph, are also overlooked.[6] Deuteride spectra are entirely omitted. On the other hand, a number of spectra which have not yet appeared in other compilations are listed. The Herzberg bands of O_2 and the Finkelnburg-Steiner bands (probably O_4) are described as a single system. Continuous spectra, although mentioned in some cases (*e.g.*, H_2O and Cl_2 absorption) are usually (*e.g.*, H_2 emission, F_2, HCl, ICl and BrCl absorption) omitted. The coverage of triatomic spectra, while not intended to be complete, is good. The selection of polyatomic spectra presented seems somewhat arbitrary.

Thus while one can not rely on these tables for completeness, they will be exceedingly useful, both for the identification of unknown bands and as a survey which will be stimulating for further research. The general plan and arrangement, and the text in general, are excellent. The typography and appearance of the book are very attractive.

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REPORTS

DEFENSE WORK OF THE CARNEGIE INSTITUTION OF WASHINGTON[1]

In accordance with authorization from the trustees, the services of staff members and the use of laboratory facilities of the Institution have been made available to the government. In some cases staff members have been given leave of absence in order to enter the rolls of governmental organizations; in others, their services have been made available while they remained on salary with the Institution, working either in our own or in governmental laboratories. At the present time eleven staff members are thus on leave, twenty others are giving full time to defense research in our own laboratories, and over forty more are devoting part time in connection with various advisory committees, as consultants to the Army and Navy, and in similar capacities. Much of the work in our own laboratories is carried on under contract with governmental agencies, the Institution being reimbursed for its added expenses in carrying out the work, but not for the regular expenses of the laboratory, the overhead or the salaries of scientists on the staff. This has allowed a greater expansion of the work than would have been possible had the Institution made the entire contribution. The heaviest burden has fallen on the Department of Terrestrial Magnetism, where nearly all the research is now on governmental problems, and the number of men in that laboratory in all categories has been more than doubled in order to carry it on. The Geophysical Laboratory, the Mount Wilson Observatory and the Nutrition Laboratory also have important efforts under way. The amount of the government funds made available for the added expenses of those programs has now reached nearly two thirds of the normal budget of the Institution.

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[1] From the Report of the President of the Carnegie Institution, Dr. Vannevar Bush.

[1] *Phys. Rev.*, 55, 636, 1113, 1939.
[2] *Ibid.*, 54, 497, 1938.
[3] *Ibid.*, 55, 894, 1939.
[4] *Ibid.*, 38, 1179, 1931.
[5] *Ibid.*, 37, 1710, 1931.
[6] *Ibid.*, 56, 769, 1939.

This type of work is now being done in scientific laboratories all over the country; it was concentrated at first, of necessity, in some of the larger institutions, but gradually it is reaching out to others. The whole program is being enlarged to meet increased needs, especially in the field of medical research.

In order that the combined effort may be properly integrated, the President of the United States has, by Executive Order, created the Office of Scientific Research and Development as a part of the Office for Emergency Management, and has given this Office the task of coordinating all defense research, and, through its subordinate bodies, of supplementing the research of the Army and Navy in the development of instrumentalities of warfare and in medical research connected with defense. The president of the Institution is director of this office, and many staff members are members of its organization. Its main offices are located in the Administration Building of the Institution, under an arrangement whereby space, furnished at first to the government at nominal cost, is now made available for government purposes without charge. The chairman of the National Defense Research Committee, which is a part of the office, is now President James B. Conant, of Harvard University, and the chairman of its Committee on Medical Research is Dr. A. Newton Richards, of the University of Pennsylvania. The office has close relations with all governmental agencies and private organizations concerned with defense research. It has especially close relations with the National Academy of Sciences, which is the advisory body to all governmental agencies on their scientific programs, and of which our fellow trustee, Dr. Frank B. Jewett, is president; and with the National Research Council, with which many of our staff are associated, the important Medical Division being headed by Dr. Lewis H. Weed, of the Board of Trustees.

Many of the dislocations and stresses produced by the emergency are not pleasant. There is, however, one decidedly pleasant aspect of the matter. Owing to the close connection of the Institution with the defense research effort there is a continual succession of visits to the headquarters of the Institution from the outstanding scientists of the country, from members of our own staff from a distance, and from the many trustees of the Institution who are concerned with various aspects of the defense problem. When the emergency is over the scientists of the country will be better acquainted with one another, and they will also be better acquainted with the Institution. This should certainly be of a real benefit when our full normal program again occupies our laboratories, and when our aid and collaboration again become fully extended to those in other institutions whose research is closely allied to our own.

SPECIAL ARTICLES

A BASIC MECHANISM IN THE BIOLOGICAL EFFECTS OF TEMPERATURE, PRESSURE AND NARCOTICS

AN important property of isolated proteins and enzymes, heretofore not adequately recognized in studies on living systems, is that of reversible denaturation. Active native trypsin has been shown to exist in equilibrium with an inactive, denatured form.[1] The equilibrium may be influenced in diverse ways, *e.g.*, temperature, acid, alkali, alcohol. Evidence that such a reversible denaturation (RD) might be of major importance in controlling the intensity of bacterial luminescence led us to undertake a re-evaluation of certain factors—temperature, pressure and narcotics—in biological systems.

For this problem the luminescence of bacteria is ideally suited. Under given conditions, the intensity of luminescence is proportional to the reaction velocity of the light-emitting enzyme, luciferase. Luminescence thus provides a unique and instantaneous measure of enzyme action within the living cell.

The influence of temperature on the luminescence intensity of two unrelated species of bacteria is shown in Fig. 1. *Photobacterium phosphoreum* is a marine, psychrophilic coccus, while *Vibrio phosphorescens* is a fresh-water, mesophilic vibrio. The essential similarity between the curves is quite apparent. The important difference is that each species has its own particular position on the temperature scale, with optimum temperatures of approximately 20° and 30°, respectively. These data clearly indicate that any factor whose influence on luminescence is affected by temperature, whether a chemical factor such as sulfanilamide (see Fig. 1)* or a physical agent (see below), must be considered in relation to the temperature characteristics of the particular species involved. Only in this way can one expect to obtain comparable results, whatever the species, or its particular range of temperature.

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[1] M. L. Anson and A. E. Mirsky, *Jour. Gen. Physiol.*, 17: 393, 1934.

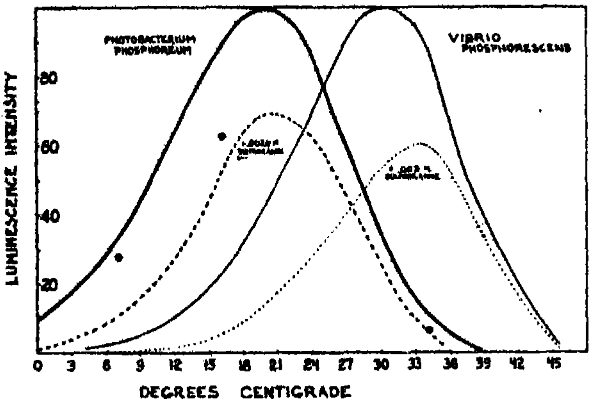


FIG. 1. The relation between temperature and luminescence intensity in suspensions of two, unrelated species of luminous bacteria, *Photobacterium phosphoreum*, (heavy line) and *Vibrio phosphorescens* (lighter line). The lines represent smoothed curves through a multitude of experimental points. The effects of moderately inhibitory concentrations of sulfanilamide are represented by the dotted lines. The solid points indicate the reversibility of heat diminution of luminescence intensity of *P. phosphoreum* when a normal suspenson is quickly warmed to 34° C., cooled at once to 16° and then to 7° C.

In regard to the temperature-intensity curves, the basic observation is that the decline in intensity above the optimum is almost entirely reversible on cooling, provided the high temperature is not maintained too long. This reversibility, previously unreported except for temperatures below the optimum, shows that neither a thermal destruction of the enzyme nor a killing of the cells is responsible for the decrease in luminescence intensity. The reversible reaction, however, does have a high temperature coefficient. The μ value of about 55,000 calories approaches the 67,600 calories reported by Anson and Mirsky[1] for the heat of reaction in the equilibrium between active native and inactive denatured trypsin. Other protein denaturations possessing temperature characteristics of the same order have been considered in relation to the theory of absolute reaction rates by Eyring and Stearn.[2] These facts strongly suggest that the decrease in luminescence intensity at higher temperatures is caused by a reversible denaturation of the enzyme, in this instance, luciferase (Harvey).[3,4]

The real key to an understanding of the intensity-temperature relation derives from the observation that hydrostatic pressure inhibits the reversible denaturation and thereby prevents the decrease in luminescence intensity which, at atmospheric pressure, occurs at high temperatures (Fig. 2).

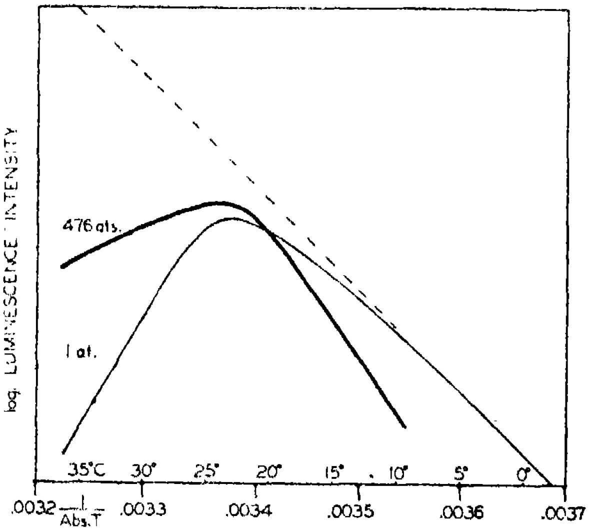
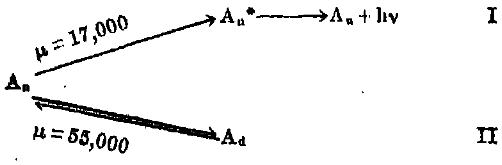


FIG. 2. The relation between temperature and luminescence at atmospheric and 476 atmospheres pressure. The extrapolated broken line shows luminescence when corrected for the reversible denaturation.

On the basis of these results, the control of luminescence may be diagrammed as follows:



wherein native luciferase, A_n, becomes excited to A_n^* in an oxidative reaction, and then emits light in a reaction independent of temperature. The oxidative reaction (I) has an energy of activation of about 17,000 calories. The amount of active, native luciferase, however, depends on the equilibrium (II) between the native and denatured forms. This equilibrium, the reversible denaturation, has a heat of reaction of about 55,000 calories. Thus, at any temperature the actual light intensity is the net result of two simultaneous reactions: (I), the primary enzyme reaction, leading to light emission, and (II), an equilibrium governing the amount of active enzyme. At temperatures low with respect to the optimum, (I) predominates and (II) is negligible. At the relatively high temperatures, (II) predominates. At either extremity, the temperature-intensity curve (Fig. 2) is practically a straight line. At the optimum, (I) and (II) balance.

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* The sulfanilamide studies have been aided, in part, by a grant to one of us (F. H. J.) from the Penrose Fund of the American Philosophical Society.

[2] H. Eyring and A. E. Stearn, *Chem. Rev.*, 24: 253, 1939.

[3] E. N. Harvey, *Erg. d. Enzymfors.*, 4: 365, 1935.

[4] E. N. Harvey, *Ann. Rev. Biochem.*, 10: 531, 1941.

The action of pressure throughout all of the temperature range (Fig. 2) may be readily interpreted in terms of the foregoing scheme. Pressure is known to retard any reaction involving an increase in volume, such as that of a molecule in going from the normal to an activated state, or as in the process of denaturation, from the initial to the final state.[5] On this basis the pressure effects become understandable and can be related to physical chemistry. At the lower temperatures (Fig. 1, below 9° for *P. phosphoreum,* and below 19° for *V. phosphorescens*) pressure reduces the light intensity by slowing the primary enzyme reaction (I) that leads to luminescence. This pressure effect, of course, is assumed to be on the process of activation, not on that of excitation directly. At temperatures above the optimum, where the reversible denaturation predominates in controlling luminescence, the effect of pressure is to increase luminescence by shifting the equilibrium (II) to the left, thereby increasing the amount of active enzyme. At the optimum temperature, pressure affects (I) and (II) to approximately the same extent, with the result that very little change in luminescence intensity is observed. It can be shown that each of these effects of pressure conforms to the Glasstone-Laidler-Eyring[5] theory of absolute reaction rates sufficiently to permit the calculation of the temperature intensity relation at any pressure. This fact, in itself, constitutes the strongest evidence that these intracellular reactions obey the same laws that govern the reaction velocity in chemical reactions generally, and it leaves little doubt as to the correctness of the interpretations and assumptions involved.

The recognition of a reversible thermal denaturation as a major factor in the temperature-velocity relation raises several points of interest. Thus, the temperature setting of the two species of bacteria may be accounted for, both in regard to the different optimum temperatures and the general form of the curves. Such differences would merely indicate that the RD reaction becomes appreciable in each species at a different critical temperature; higher for some, lower for others. Basically, such specific differences, it would seem, must be genetic; but in a given organism, any factor which would influence the RD reaction or equilibrium would tend to shift the optimum temperature, as well as to affect the absolute intensity and the temperature coefficient. There are numerous biological phenomena which might be considered from this point of view.

In the majority of biological reactions the rate or intensity of a given process agrees with the Arrhenius relation for the velocity of a chemical reaction over a limited but clearly recognizable range of temperatures. With some justification this agreement has been interpreted as evidence that the course of events is under the control of a particular chemical reaction, having a definite temperature coefficient or μ value. Deviations, prone to occur as the temperature is raised toward the optimum, have been variously interpreted. Prominent among the explanations that have been advanced is the theory of Crozier. This theory postulates that a series of consecutive reactions, each with a different temperature characteristic or μ value, is involved in any biological process. According to their μ values, different reactions in the series have been thought to become the pace-setting, or "master reaction" at different temperatures. Deviations or "breaks" in the straight-line regions of the Arrhenius plot are presumed to represent points at which different reactions in the series assume control over the velocity of the process. According to the views expressed in the present paper, however, such "breaks" would represent the point at which the RD reaction, or equilibrium, becomes significant. In contrast to the Crozier theory, this is a simultaneous reaction, involving the same molecule, rather than a consecutive member of a series of reactions. Furthermore, the RD has a high temperature coefficient, whose true value is revealed only at temperatures beyond the optimum, or by introducing another variable, namely, pressure. Indeed, from the pressure-temperature-intensity data, it can be shown that, were it not for the RD equilibrium, the logarithm of luminescence intensity plotted against 1/T would constitute a straight line, without a break, for a considerable range beyond the normal optimum (dotted line in Fig. 2).

Since alcohol and certain other substances are known to influence the RD equilibrium of isolated proteins it is interesting to consider the possibility that the RD reaction might be the fundamental basis of narcosis by such substances in the living cell. At the optimum temperature, pressure has little effect on the luminescence intensity of normal suspensions. If this intensity is first reduced by the addition of any of a series of lipoid soluble narcotics, pressure will largely or completely abolish the inhibition. Compounds included in this group are ether, alcohol, chloroform, ethyl carbamate, phenyl carbamate and novocaine. According to the views already expressed, these substances must cause a shift in the RD equilibrium, leading to the increased volume of the denatured molecule, reversible by pressure. Another group of narcotics decreases luminescence in a manner that is not reversible by pressure, although the inhibition is largely abolished by removing the substance from the suspension medium, or in certain cases by temperature. Barbiturates, chloral hydrate, sulfanilamide and p-aminobenzoic acid belong in this latter group, which must act by a different process, perhaps a chemical or adsorptive combination with the enzyme. Members of both groups, *e.g.*, urethane and sulfanilamide, have been found to act on the enzyme, without affecting the total luminescence, of extracted *Cypridina* luciferase and purified luciferin.[6] The significant point is that pressure effects make it possible to identify the probable action of the first group, in spite of the diversity of the chemical structure, as affecting the reversible denaturation of the enzyme, and to distinguish this from the action of another large group of narcotics.

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[5] Glasstone, Laidler and Eyring, "The Theory of Absolute Reaction Rates." New York: McGraw-Hill, 1941.

Although the foregoing discussion has been restricted primarily to bacterial luminescence, it should be emphasized that the principles developed apply equally well to the energy exchanges of muscle. Here it can also be shown that the RD reaction determines the augmentation in tension which is obtained when pressure is applied at temperatures above the optimum, whether in muscles from tropical or temperate animals. Deviations from the Arrhenius relation may be shown to depend on the interference of a reversible denaturation with a high μ value. For this reason we would expect to find the RD processes conditioning the effects of temperature, pressure and chemical agents generally. The further delimitation of this type of reaction would seem, therefore, to be of the utmost importance.

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[6] F. H. Johnson and A. M. Chase, *Jour. Cell. Comp. Physiol.*, in press.

SUCCESSFUL REARING OF A SECOND GENERATION OF MICE ON AN ARTIFICIAL DIET

IN view of the known difficulty in raising mice on highly artificial rations we offer this preliminary report of the rearing of a second generation of this species on such a diet. The basal ration, as used, consisted of Labco casein, cerulose, crisco, Osborne and Mendel salt mixture with added zinc carbonate, agar, wheat germ oil and 3 per cent. rice polish filtrate factor II. This basal mixture was supplemented with cod liver oil concentrate, thiamine, riboflavin, pyridoxine, nicotinic acid, calcium pantothenate, choline, para-amino benzoic acid and inositol.[1] During the past month, linoleic acid has been added. The actual proportions of components used in the above diet (Diet A–2) as worked out by McElroy will be published later.

A group of 14 strain C_{57} black mice,[2] 5 males and 9 females, were placed on Diet A–2 at weaning. Of these 14, all 5 males and all but 2 of the females are alive and well after 184 days of subsistence on this diet. Growth curves of the whole group and their descendants in addition to the history of 10 of the original animals will be reported later, as not all the females were allowed to mate as soon as they were mature. Three females (Nos. 9, 8 and 12) were mated with a sibling male initially. To date female 9 has had 3 litters with a total of 10 live and 4 dead young. She did not lactate until the third litter was born on the 157th day of subsistence on the diet. Of this third litter of 4, she has successfully raised to weaning 3 young.

As a result of the first mating females 8 and 12 had litters totalling 10 live and 1 dead young on the 55th day on the diet. Both females lactated and 8 of the young (f_1) were raised to weaning and placed on Diet A–2; one young male died subsequently from an accident. At 69 days of age the 4 young females (f_1) were allowed to mate with two male siblings. All these females became pregnant readily, but one died of peritonitis 9 days after a vaginal plug was found. When 91 days of age, the 3 remaining females had litters totalling 16 live and no dead young. One of the young from each litter died during the first day of life. Although these were first litters, all three mothers lactated. Lactation gradually ceased in 1 mother and her 3 young were dead by the 13th day. The other 2 mothers reared their litters of 4 and 6 young successfully to weaning at 21 days of age. These 10 second generation (f_2) mice are now alive and growing well on Diet A–2 at 41 days of age.

The two original females (Nos. 8 and 12) have successfully reared second litters, weaning 9 out of 11 young born alive on the 135th day of subsistence of these mothers on Diet A-2. Obviously the stock diet fed to these mice (Nos. 8 and 12) prior to the start of the feeding experiment in which Diet A-2 has been used, can not be regarded as playing a role in determining the success in reproduction and lactation of these mice with their second litters.

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[1] We are indebted to Merck and Company for supplying in pure form the various members of the vitamin B complex used in these experiments.

[2] Supplied by Dr. L. C. Strong.

It is interesting to note, in reporting our success with the C_{57} mice, that there may be a strain difference in mice as regards reproduction and even continued maintenance of life on artificial diets, since attempts to duplicate our results using Diet A-2 and a different strain of mice have been unsuccessful to date.

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FERTILE TETRAPLOIDS OF SESAME, SESAMUM INDICUM LOEW, INDUCED BY COLCHICINE

Sesamum indicum Loew is a plant of the family Pedaliaceae which originated in tropical Asia and has been cultivated since ancient times for the high quality oil of its seeds. Although it has been used in all the tropical and subtropical countries for so many years, it is known only in its diploid form of 26 chromosomes.

In September, 1940, the axillary buds of some sesame plants were treated with 0.5 per cent. colchicine in lanolin and others with 0.4 per cent. colchicine emulsion.[1] With either of the two preparations severe burning and dying back of the leaves occurred, followed by the formation of callus-like tissues and new buds.

When new branches developed the four-celled mucilage-producing glands of the leaves were larger on some than on others. Leaves with larger glands had correspondingly larger but fewer stomata than those with smaller glands. Chromosome counts in the pollen mother cells of the branches with large glands revealed that a few of them had the tetraploid number, 52, while others had between 26 and 52. Some of the branches with 52 chromosomes were fertile. It is highly probable that if only a small number of plants had been treated with colchicine, no fertile branches would have been obtained.

Most of the normal branches were severed, but a few were left to furnish material for a direct comparison between fertile tetraploids and diploids on the same plant. The data in Tables 1 and 2 were obtained from 20 of these plants.

TABLE 1

Type of branch	Number of glands per cm² of leaf area	Size of glands	Total volume of glands per cm² of leaf area
	per cent.	per cent.	per cent.
Diploid . . .	100	100	100
Tetraploid.	68	204	180

TABLE 2

Variety	Type of branch	Average number of seeds per pod	Average weight of 1,000 seeds	Average weight of seeds per pod	Comparative weight of seeds per pod
			grams	grams	per cent.
Jaffa	Diploid	91	3.41	0.310	100
	Tetraploid	90	5.04	0.454	146
Colombiano	Diploid	58	2.60	0.151	100
	Tetraploid	55	4.23	0.233	154
Criollo	Diploid	55	2.56	0.141	100
	Tetraploid	56	4.12	0.231	164
Selection 3	Diploid	53	2.58	0.137	100
	Tetraploid	52	4.19	0.218	159

The average increase in size of seeds obtained by doubling the chromosome number was 56 per cent. There was no reduction in the number of seeds per pod nor in the number of pods per branch.

By subsequent colchicine treatment, hybridization and selection, haploids, diploids, triploids, tetraploids, hexaploids and octoploids have been obtained. Field tests of the comparative seed yields, quantity of mucilage, and per cent. of oil of the various types have not yet been completed.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODEL GEYSER

GEYSERS, which are special types of hot springs that gush or erupt into the atmosphere at various intervals, are one of the most intriguing of natural phenomena and have held the interest of geologists and laymen alike for many years. As a result of this interest, many theories and modifications have been presented to explain the cause and manner of the eruptions. In addition, there have been a number of experimental geysers constructed throughout the last 100 years, more or less. Some models have worked directly on, or upon some modification of, the most widely accepted geyser principles, whereas others have been merely jets of water or steam thrown into the air at intervals by some foreign influence.

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[3] The expenses of this investigation were defrayed in part by a grant to G. R. C. from the Research Fund of the Yale University School of Medicine.

[1] Prepared by L. F. Randolph, of the Department of Botany, Cornell University, and Division of Cereal Crops and Diseases, Bureau of Plant Industry, Washington, D. C.

Allen and Day[1] recently studied the hot springs, including geysers, of Yellowstone National Park and have not only presented some interesting new facts, but have also entered into a thorough discussion of older theories and observations. The reader is referred to their work for a concise discussion of geyser principles and occurrences.

In general, the recognized requirements for continued geyser action are: (1) A subterranean chamber connected by a tube vent or orifice with the surface of the ground. (2) A heat supply in excess of the surface boiling point temperature of water. (3) An intermittently replenished inflow to the heating area and tube vent of water which is cooler than boiling temperatures.

When the construction of a working model was undertaken by the authors, several disadvantageous conditions became apparent, namely, (1) specific literature and statistical data on geyser model construction are sparse and not readily available; (2) models, observed by the writers, generally were built so that they had little or no semblance to natural conditions and usually required an outside stimulus in operation or; (3) the expense and involved apparatus used in working models that did partially approach natural phenomena were prohibitive of simple and cheap construction. Proceeding on the lines, therefore, that the desired objective was a model which would simulate, as near as possible, the field characteristics of most geysers and which, at the same time, would be relatively inexpensive and easily built, the model construction herein described was undertaken.

Landscape: The landscape, which also acts as a catchment basin, and returns ejected water to the system, measures 5 feet by 5 feet in plan dimension. It was built on a 3-ply veneer wood base (salvaged packing box) to which 1-inch by 2-inch cleats were fastened on the underside for stability and for a foundation so that the sides, made of 1-inch by 4-inch boards, could be nailed securely. Three holes were drilled in the central area of the box-like structure thus formed, and into these a vent pipe (glass tube) and two glass drainage funnels were inserted. Wet excelsior, that had been soaked in a very thin mix of plaster of paris, was then placed in the box and was shaped into the desired topography. This, in turn, was covered by wet burlap cloths and over the cloths a heavy, thick plaster of paris coating was applied and smoothed out to conform with the previously formed relief. Care was taken to insure that the drainage funnels were at the lowest elevations of the landscape and that the geyser orifice was relatively high.

After the plaster had set for 24 hours, the first of a series of 6 coats of shellac were applied to the modeled surface. Possibly it was not necessary to apply this number of shellac thicknesses, but, in so doing, a sufficiently tough skin was developed to withstand continual drenching by the hot waters for a period of 14 hours without appreciably softening the underlying plaster.

Inasmuch as all other necessary details of the construction and geyser set-up are shown on the accompanying sketch (Fig. 1), they are not repeated here.

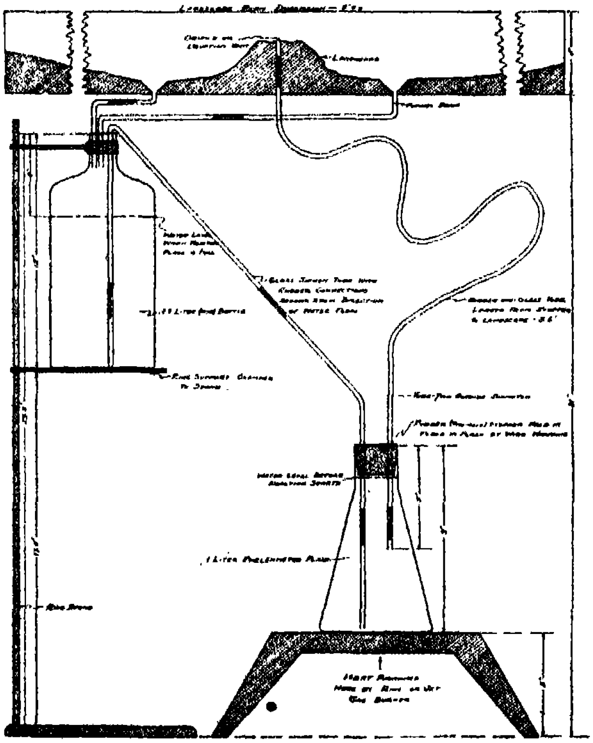

Fig. 1. A model geyser.

When the geyser is "playing," hot water and steam are ejected every 1.5 minutes approximately to a maximum height of 3.5 feet. The period between eruptions varies slightly with the temperature of the water system. When the circuit becomes heated to a uniform temperature through the continued return of warm water which has been ejected, the eruption period becomes stabilized. 15–20 cc of water must be added to the system about every hour in order to replace that which has been discharged and lost as steam. The new water is introduced by simply pouring it out over the landscape where it enters the circuit through the drain funnels.

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[1] E. T. Allen and Arthur L. Day, Publication No. 466, Carnegie Institution of Washington, pp. 171–231, 1935.

Delicate adjustments of conditions must be established for satisfactory operation of the model, but fortunately they can be made readily and with ease as the equipment is being put into operation. For instance, the height of the reservoir above the heating chamber and the heat applied are variables that must be controlled. That is, under a given heat constant the reservoir can not be too high or proper siphoning action will not develop and continual steaming of the heating chamber will result. Conversely, if the reservoir is too low there may not be enough back pressure to cause an eruption through the orifice and a bubbling back into the reserve water may ensue. The adjustments can be made by raising or lowering the ring stand, or the heat may be increased or lessened, or both reservoir height and heat may be varied. The reservoir can not, of course, be elevated above the landscape in this model (see Fig. 1).

Since different atmospheric pressure conditions will govern the particular interrelations of heat, water supply, etc., no studies of the operating temperatures and gas consumption were made. These factors are largely dependent upon the altitude of the locality in which the model is operated, and, therefore, should be expected to vary somewhat.

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ORIGIN OF DIPEPTIDASE IN A PROTOZOAN

PARAMECIUM is apparently the sole diet of the ciliate *Didinium nasutum*. Dipeptidase extracts from both organisms show identical pH optima (7.4–7.6) for the hydrolysis of alanylglycine. When deprived of food Didinium continues to divide, but there is no change in the quantity of dipeptidase present. For example, a parent Didinium has exactly twice the enzyme content of each of its daughter cells and four times that of each of the cells produced by the succeeding division. *Paramecium multimicronucleatum*, which is somewhat larger than the largest Didinium, is entirely ingested by Didinium in about one minute. Immediately after ingestion a single large food vacuole is present in the Didinium and this vacuole divides into a large number of small ones in about twenty minutes. Morphological changes indicating digestion of the Paramecium occur rapidly.

High values for the dipeptidase content of *P. multimicronucleatum* were obtained by the addition of liberal quantities of dried brewer's yeast to a previously boiled hay infusion. The enzyme content of single individuals of *P. multimicronucleatum* was readily determined, but marked variations between individuals are usual. Thus, individual variations in physiological condition as well as in size make the selection of quantitatively uniform individuals infeasible.[1] Greater uniformity could be obtained with genetically pure strains of *P. aurelia* supplied by T. Sonneborn, but the enzyme content of these was too low for this work.

When single didinia were fed single paramecia and left for various time intervals up to four hours, the enzyme content was consistently found to equal the sum of that of predator plus prey within the range of individual variation of the paramecia (the enzyme content of the didinia can be predicted precisely). The dipeptidase content of groups of twenty-five organisms from single cultures of each species is quite constant. When twenty-five *Paramecium multimicronucleatum* were added to a drop containing twenty-five hungry didinia, the paramecia were all eaten in about one half hour, some didinia eating two and some none. When such didinia were left for four hours and the dipeptidase content then determined, it was found that the enzyme content was equal to that of the original didinia plus that of the ingested paramecia. Uniform extraction of the dipeptidase and sterility of the extract was obtained by repeated freezing and thawing with dry ice. This procedure does not impair the dipeptidase activity. It is to be borne in mind that the methods employed show the enzyme content of the cells and do not indicate the intracellular enzyme activity. In view of the digestion time allowed (about the duration of one cell-generation) one may conclude either that Didinium dipeptidase is synthesized at exactly the same rate that paramecium dipeptidase is being destroyed or else, and more probably, that paramecium dipeptidase is taken over quantitatively by Didinium.

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[1] H. Holter and W. Doyle, *Jour. Cell. Comp. Physiol.*, 12: 295–308, 1938.

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PHYSIOLOGY AND HIGH ALTITUDE FLYING: WITH PARTICULAR REFERENCE TO AIR EMBOLISM AND THE EFFECTS OF ACCELERATION[1]

By Dr. J. F. FULTON

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I. INTRODUCTION

"YE who listen with credulity to the whispers of fancy, and pursue with eagerness the phantoms of hope; who expect that age will perform the promises of youth, and that the deficiencies of the present day will be supplied by the morrow; attend to the history of Rasselas, prince by Abissinia.

"Rasselas was the fourth son of the mighty emperour, in whose dominions the Father of waters begins his course; whose bounty pours down the streams of plenty, and scatters over half the world the harvests of Egypt.

"According to the custom which has descended from age to age among the monarchs of the torrid zone, Rasselas was confined in a private palace, with the other sons and daughters of Abissinian royalty, till the order of succession should call him to the throne."

AND the account goes on to say that the palace of Rasselas was in a spacious Abyssinian valley into which came artists and men of science to advance the culture of its happy Utopian population. It so happened one year that a famous artist and engineer came to the valley to settle and the young prince made frequent visits to his house. One day the engineer told Rasselas:

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[1] Sigma Xi Lecture delivered before the Yale Chapter in Sage Hall, Yale University, Wednesday, October 15, 1941, and The Duke University Medical Defense Symposium, October 16, 1941.

"I have been long of opinion, that, instead of the tardy conveyance of ships and chariots, man might use the swifter migration of wings; that the fields of air are open to knowledge, and that only ignorance and idleness need crawl upon the ground (1, p. 35). . . . He that can swim needs not despair to fly; to swim is to fly in a grosser fluid, and to fly is to swim in a subtler. We are only to proportion our power of resistance to the different density of the matter through which we are to pass. You will be necessarily up borne by the air, if you can renew any impulse upon it, faster than the air can recede from the pressure (1, p. 36). . . .

"The labour of rising from the ground," said the artist, "will be great, as we see it in the heavier domestick fowls; but, as we mount higher, the earth's attraction, and the body's gravity, will be gradually diminished, till we shall arrive at a region where the man will float in the air without any tendency to fall: no care will then be necessary, but to move forwards, which the gentlest impulse will effect" (1, p. 37–38).

At this juncture Rasselas thought his engineer had gone astray and interjected,

"All this . . . is much to be desired, but I am afraid that no man will be able to breathe in these regions of speculation and tranquility. I have been told, that respiration is difficult upon lofty mountains, yet from these precipices, though so high as to produce great tenuity of the air, it is very easy to fall: therefore I suspect, that from any height, where life can be supported, there may be danger of too quick descent" (1, p. 39).

Rasselas, although unconvinced, was interested and urged the engineer to proceed. This he did under one condition, namely, that Rasselas would divulge to no one the secret of making wings.

"Why," said Rasselas, "should you envy others so great an advantage? All skill ought to be exerted for universal good; every man has owed much to others, and ought to repay the kindness that he has received."

"If men were all virtuous," returned the artist, "I should with great alacrity teach them all to fly. But what would be the security of the good, if the bad could at pleasure invade them from the sky? Against an army sailing through the clouds neither walls, nor mountains, nor seas, could afford any security. A flight of northern savages might hover in the wind, and light at once with irresistible violence upon the capital of a fruitful region that was rolling under them. Even this valley, the retreat of princes, the abode of happiness"—this Abissinia—"might be violated by the sudden descent of some of the naked nations that swarm on the coast of the southern sea" (1, p. 41).

And so Rasselas promised secrecy. The wings were made and the wings were tried, but, like Icarus, the inventor fell into the sea, for he lacked the motive power to flap his wings; and Rasselas rescued his engineer from a watery grave.

Thus, ladies and gentlemen, did Samuel Johnson in 1759 depict the problems of aviation medicine and their relation to warfare. Rasselas was something of a physiologist by temperament, his friend was an inventive engineer, but the engineer was also a realist, for he insisted that certain things can not for the moment be told to the world lest it jeopardize the "security of the good."

If the history of aviation were to be written one would come quickly to appreciate Dr. Johnson's astonishing prescience in characterizing so vividly the developments of modern aeronautics. The modern aeronautical engineer has placed primary emphasis upon design, upon the attainment of speed and quick manoeuverability; in some modern combat planes virtually everything has been sacrificed to gain these two objectives—everything sacrificed including the pilot. It is no secret, for example, that until very recently some of the new bombers designed to fly at 35,000 feet were so cold inside at that altitude as to make it quite impossible for a crew to function effectively for more than a few minutes. I will return to this in a moment.

The second development in modern combat flying has arisen from recognition of the need for protecting the pilot, and at long last aviation engineers are getting together with flight surgeons—and even with physiologists—recognizing that the physical limitations of the pilot are quite as important as the physical characteristics of the machine, and that both must be considered in designing and operating combat aircraft. I propose to deal with three phases of the problem, all essentially physiological, affecting pilot performance at high altitudes, (i) temperature, (ii) aero-embolism and (iii) effects of high acceleration.

II. TEMPERATURE

Under standard atmospheric conditions the temperature at 38,000 feet is 55° below zero Fahrenheit; above that stratospheric level the temperature falls but little. The pilot, or the gunner in the open turret, exposed to such a temperature for 8 hours with a wind velocity of 20 m.p.h. is worthless as a gunner; occasionally indeed he has turned out to be a cake of ice.

There have been many studies in war and in peace time of the influence of cold on human performance. In a word, exposure to intense cold for a sufficient duration to cause perceptible lowering of the rectal temperature makes motor performance slow and inaccurate, and cerebral activity, as indicated by the ability to solve simple problems or to follow simple directions by radio, is gravely impaired. As with nearly all problems involving stress, some individuals are much more affected than others.

The designing engineers have given us planes that will fly to 35,000 and even 40,000 feet, but at first they largely forgot the pilot and the crew, believing that inconveniences from extremes of temperature could be taken care of by clothes from Quartermaster Corps. In single-motored fighter planes, there is little trouble from cold, even in the high altitude ranges, since the pilot sits behind the engine and the cockpit receives direct warmth from it; but in all larger twin-motored or four-motored planes, especially the long-range bombers, the bomb bay is generally open to the outside air and the heating arrangements, especially in the American-made planes, were not only inadequate, but in some of the better known the heating facilities are virtually useless, heaters having been put in the top instead of the bottom of the fusilage. Enormous quantities of heat are available from the exhaust of the long-range bombers, and with little alteration in basic design the exhaust could be made to heat any strategic point in the plane, including the gunner's position. The gunner is more exposed to cold than any other member of the air crew, for in most planes his station in the blister receives the full blast of outside air from the horizontal machine-gun aperture, and in a long mission, the gunner may be at his position for eight hours or more at an altitude of 20,000 feet, at which level the outside temperature would be 25° below zero.

Numerous proposals have been made to combat low temperatures, *e.g.*, electrically heated suits, boots and gloves, and there have been many designs of other types of clothing. Most acute, however, is the need for an oxygen mask and an oxygen line of supply that does not freeze up during prolonged exposure to low temperatures. The Army and Navy have recently released for manufacturers their criteria for oxygen supply systems in which they insist that the oxygen mask and accessory supply valves must not freeze up in one hour with temperature $-40°$ Centigrade in the face of a wind velocity of 10 m.p.h. at an altitude of 37,500 feet. Every mask commercially available at the present time freezes up solid after about 10 minutes of such punishment. Those of you who have recently seen the popular film "Dive Bomber" will have had vividly portrayed the consequences of a frozen system of oxygen supply.

And there are also many vicious circles in connection with cold and high altitude. If very heavy clothing is worn, the crew must do more work in moving about and hence require more oxygen. If the oxygen supply clogs or freezes at 35,000 feet, especially that of a crew member moving heavy bombs, he falls unconscious within 15 seconds or less and the duties of other crew members are generally of such a nature as to prevent their giving prompt assistance. I can not tell you in detail how the problem of cold is being met here or in England, but one can say this, that the flight surgeon is still forced to employ many awkward expedients—all of them I hope temporary—until the heating engineers have solved their phase of the problem, which includes heating, as well as ventilation and also watching for carbon monoxide and other toxic gases.

III. AERO-EMBOLISM

Some of the faster interceptor planes may gain altitude at the surprising rate of a mile a minute; this brings them, if that rate of ascent is maintained, from sea level to 35,000 feet in roughly 7 minutes. Actually, the rate of ascent is inevitably slower in the rarefied air, but it is stated in the newspapers that some of our new fighters have attained altitudes of 36,000 and 37,000 feet within 10 minutes of the time they took off. The pressure of air at 34,000 feet is a quarter of that at sea-level atmosphere—190 mm Hg instead of 760 mm. An aviator arising to 34,000 feet thus subjects himself to the same relative decompression as that experienced by a diver ascending from 100 feet of water—which is equivalent to 4 atmospheres—to the surface level. If a diver ascends too rapidly, nitrogen bubbles tend to form in the tissues and blood stream, and in the same way aviators who subject themselves to rapid decompression are likely to experience the symptoms of bubble formation in their tissues. To divers and to caisson workers, the painful syndrome has long been known as "bends" because the excruciating character of the pains causes those affected to "double up."

The tendency of bubbles to form in the blood under conditions of decompression was first observed by Robert Boyle in the course of those celebrated experiments in which he weighed the air, determined the reciprocal relationship between volume and pressure, and compared combustion with respiration (1662). Boyle observed that when freshly drawn blood was placed in a decompression chamber bubbles were evolved on the surface of the blood as air was being sucked out of the chamber. He asked himself whether these bubbles did not represent the fraction of the air normally taken up when blood passes through the lungs. If this were true, he argued, bubbles should appear in the blood vessels of animals subjected to rapid decompression. Although Boyle's premise was not wholly correct he was led through this reasoning to make one of the most important observations in the history of our subject. Small bubbles do, in fact, appear in the circulating blood of animals subjected to decompression and this is how Boyle described it in a short note in the *Philosophical Transactions* for September 12, 1670 (2).

> Note, that the two foregoing Experiments were made with an Eye cast upon the inquiry, that I thought might be made; Whether, and how far the destructive operation of our Engin upon the included Animal, might be imputed to this, that upon the withdrawing of the Air, besides the removal of what the Airs presence contributes to life, the little Bubbles generated upon the absence of the Air in th Bloud, juyces, and soft parts of the Body, may by their Vast number, and their conspiring distention, variously streighten in some places, and stretch in others, the Vessels, especially the smaller ones, that convey the Bloud and Nourishment; and so by choaking up some passages, and vitiating the figure of others, disturbe or hinder the due circulation of the Bloud? Not to mention the pains that such distensions may cause in some Nerves, and membranous parts, which by irritating some of them into Convulsions may hasten the death of Animals, and destroy them sooner by occasion of that irritation, than they would be destroyed by the bare absence or loss of what the Air is necessary to supply them with, and to shew how this production of Bubbles reaches even to very minute parts of the Body, I shall add on this occasion (hoping that I have not prevented my self on any other,) what may seem somewhat strange, what I once observed in a *Viper*, furiously tortured in our Exhausted Receiver, namely that it had manifestly a conspicuous Bubble moving to and fro in the waterish humour of one of its Eyes [p. 2044].

Within the past year, our public press has made a great to-do about the dangers of aero-embolism in aviation, and unfortunately the popularity given to the subject has made the average military flier unduly apprehensive about the dangers of "bends." Owing to the developments of the last year, most of which are about to be described in an important paper by Lieutenant Commander A. R. Behnke in the next number of the *Military Surgeon*, "bends" would seem no longer to be a serious problem in military aviation. I would like to state this categorically, and if the press is disposed to cite anything from this paper I hope it will stress this point. The new developments may be briefly outlined as follows:

1. *Denitrogenation* (*a*) *with oxygen.* It has long been suspected that "bends" arise primarily from nitrogen bubbles rather than from oxygen, carbon dioxide or the rarer gases, since nitrogen comprises 80 per cent. of normal air and is rather slow to pass through cell membranes. Once a nitrogen bubble appears, therefore, it is not rapidly absorbed. By breathing pure oxygen for a prolonged period, all the nitrogen of the body, or virtually all of it, can be disposed of. Dr. Behnke (3) has found that when the body is completely denitrogenated, previously susceptible subjects fail, after exposure of several hours to altitudes of 40,000 feet, to develop "bends." Unfortunately the curve of nitrogen elimination shown in Fig. 1 indicates that pure oxygen must be breathed for at least five hours before 95 per cent. of the body's nitrogen is eliminated. Obviously, therefore, preoxygenation is not a feasible way of preventing "bends," especially for fighter pilots who could not be expected to stay in an atmosphere of pure oxygen for five hours prior to each ascent. The same is true of bomber crews. However, an hour of breathing pure oxygen, as, for example, if the pilot puts on his oxygen mask immediately he enters his plane, will diminish "bends" susceptibility, but will not prevent its ultimate appearance if the exposure to high altitude continues for a long period. In a susceptible subject studied by Commander Behnke severe "bends" developed between 25,000 and 28,000 feet without preoxygenation. With 45 minutes preoxygenation "bends" did not develop until 30,000 feet; with 90 minutes preoxygenation the ceiling was raised to 34,000 feet; with 3 hours to 37,000 feet and after 5 hours preoxygenation the "bends"-susceptible subject withstood 40,000 feet for 2 full hours without experiencing symptoms.

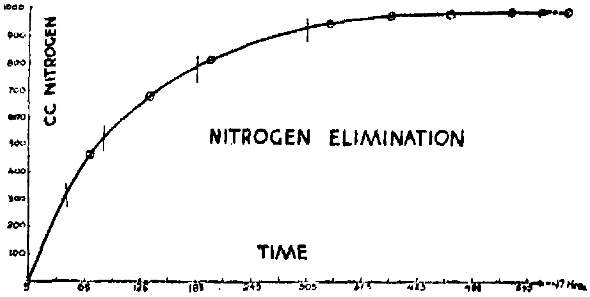

FIG. 1

(*b*) *Helium.* Oxygen for prolonged administration is hazardous because of its toxicity. Nitrogen can be removed as effectively from the body of a helium-oxygen mixture as with pure oxygen. Since helium is only one third as soluble in fat as is nitrogen, the quantity of gas available for bubble formation, especially in the bone marrow, which comprises as much as 90 per cent. fat, is greatly reduced. If a human being were saturated with helium, instead of nitrogen, it would require only 90 minutes of oxygen inhalation to eliminate dissolved helium in contrast to the 5-hour period for nitrogen elimination. Commander Behnke believes it would be practicable to have bomber pilots in a ready room filled with an atmosphere of oxygen and helium prior to flight. So far, however, this proposal has not had service trial.

Preselection for high altitude service. The susceptibility to "bends" varies enormously in different individuals, and little is known as yet of the basis for the differing susceptibilities. The younger age groups are less susceptible than the older, and any one having an injury to a joint is prone to develop "bends" at the site of injury. Pilots in the age group of 18 to 24 can often withstand prolonged exposures to altitudes as high as 40,000 feet without developing the symptoms. Behnke and others have recently stressed this point, and it has now become possible on the basis of decompression chamber tests to single out for the high altitude squadrons those pilots who can stand, say, 35,000 feet for 4 hours without developing untoward symptoms. At least 50 per cent. of the young adult population fall into this category, and it is probable that with training the percentage will be even larger. Hence, if pilots are selected through preliminary decompression chamber tests as fit for high altitude operations, "bends" ceases to be a serious military problem.

All the preventive measures elucidated by Commander Behnke and others, even for those who appear to be unsusceptible to "bends," such as taking oxygen from the ground up, ascending slowly and indulging in the limited amount of exercise possible in the cockpit of a plane, are also recommended for observance.

It is possible that certain drugs may diminish "bends"-susceptibility, but as yet there is no panacea for protecting a susceptible subject except for a full 5 hours of preoxygenation.

IV. EFFECTS OF ACCELERATION

An aircraft flying along the curve of any circle, whether in pulling out of a dive, a tight turn or a diving spiral will have acting upon it from the center of the circle a centrifugal acceleration which varies directly as the square of the linear velocity and inversely as the radius of the circle. The actual weight attained by a body during acceleration is the product of the mass and the acceleration expressed in terms of the normal attraction of gravity, *i.e.*, 1 *g*. At a centrifugal acceleration of 7 times the force of gravity (7 *g*), a pilot weighing 180 pounds normally would have a weight, so long as the 7 *g* is sustained, of 1,260 pounds. Every tissue in the body takes part in this increase in weight and as the current RAF *Manual* puts it "at 6.9 *g* the blood becomes as heavy as molten iron." During such acceleration the weight of the hydrostatic column of blood is too great for the heart to cope with on the arterial side and venous blood fails to be returned to the heart from regions of the body below the cardiac level. Hence there tends to be a pooling of blood in the abdomen and lower extremities and failure of the cerebral circulation. The effect of diminished circulation to the retina of the eye manifests itself in graying, and, finally, in ultimate failure of vision—giving the phenomenon of "blackout." When vision goes, consciousness is likely to fail shortly thereafter.

There is a time factor in acceleration as important physiologically as the absolute magnitude of the centrifugal force itself. The average young adult can withstand sitting in the upright position 5 *g* for 4.5 seconds. He might also stand 7 *g* for 2 seconds, but no normal adult can withstand 7 *g* for 7 seconds without complete loss of consciousness. This means that neurons of the brain are so intimately dependent upon their supply of oxygen that when this is withdrawn by centrifugalizing the blood away from the head consciousness lapses, usually within 5 seconds.

The capacity to withstand acceleration varies in different individuals, and in the same individual at different times. Test pilots have found that an alcoholic spree of an evening considerably diminishes their tolerance for positive acceleration the next day. Relative anoxia, such as may occur in high altitudes when the oxygen supply is inadequate, likewise diminishes resistance to acceleration, and it is likely that the level of the blood sugar is similarly important. In recent German literature various expedients have been recommended to assist the pilot to withstand positive acceleration. These may be enumerated briefly.

1. *Full stomach.* In the recently published diary, "I was a Nazi Flier," there is a diverting chapter on aviation medical research in Germany in which it is stated that all resistance on the part of pilots to being experimented upon was overcome when it became known that the "doctors" had recommended that the pilots of Stuka dive bombers should have a large beefsteak before going off on a mission! From other sources (*e.g.*, Ruff and Strughold, 1939, 4) it is clear that the German flight surgeons insist that an empty stomach diminishes tolerance to high acceleration. When the stomach is full the visceral blood vessels are also distended so that more blood can not readily enter them—so runs the German explanation. Blood chemistry, no doubt, also plays a part in determining resistance to *g*.

2. *Carbon dioxide.* Use of 5 or 6 per cent. carbon dioxide, which through increasing the cerebral circulation is said by the Germans to increase resistance to acceleration by 1 to 2 *g*. (Ruff and Strughold). This is doubted by other authorities.

3. *Vasoconstrictor drugs.* Any pharmaceutical agent which increases the "tone" of the capillary wall improves one's *g* ceiling. Pituitrin, adrenalin and adrenal cortical hormones have all been mentioned in

this connection, but precise data concerning these are not available.

4. *Pneumatic belts.* Mechanical constriction of the abdomen as well as of the lower extremities has also been proposed in both the German and English literature to minimize the rush of blood from the head to the visceral bed and the lower extremities. Of these mechanical devices, pneumatic belts and pneumatic trousers have been most under discussion. The Germans state that a pneumatic belt may increase *g* tolerance by 1 to 1.5, but no one of the present belligerent countries has permitted publication of detailed reports concerning the actual effectiveness of this equipment.

5. *Water suits.* The Germans have also reported on a "water suit" designed for the prevention of blacking out, and while they claim it notably improves resistance to positive acceleration they state that it is unsatisfactory for other reasons. To quote Grow and Armstrong (1941, pp. 276–277):

> The water suit is a closely fitted water-proof garment which is worn next to the skin. What little space is left in the suit after it is put on is filled with water or other suitable fluid. This causes the flier to "float" in the suit, and during accelerations the water presses on the body equally in all directions. As a consequence the normal effects of acceleration are replaced by a uniform compression of the body which, it is estimated, could be tolerated without difficulty up to 15 gs or more.

6. *Posture.* In a recent paper by Ruff (1940) in *Medizinische Klinik* the problem of posture in relation to acceleration was discussed. The Germans, it appears, favor a crouching posture with flexion of the legs against the abdomen as one particularly suited for protection of the pilot against acceleration. This would bring the hydrostatic column of blood in the leg veins nearer to the heart level. If the pilot lies supine or prone at the end of a dive-bombing manoeuvre, he is also less subject to negative accelerations, but in these postures he is unable to see out or to manoeuvre his plane without special redesigning of the cockpit and the cockpit controls.

It should be noted that all factors tending to improve the body's resistance to positive acceleration are those which tend to keep blood in the head. From this it may be concluded that the phenomenon of blacking-out and loss of consciousness which may occur within 5 seconds of the beginning of the acceleration is probably due solely to acute anoxia, and can not be attributed to any direct effect of acceleration *per se* upon the cortical neurons.

V. CONCLUSION

Many other phases of aviation medicine might be discussed, but since there are certain topics that can not be gone into fully at the present time—having in mind Rasselas's "Security of the good"—I have omitted mention of night vision, instrument lighting, the oxygen mask, the adrenals and Drs. Nims and Clarke's studies of pH in anoxia, until some later time when restrictions are less imperative than at present. I hope, however, that I have been able to indicate some of the more important developments as well as the intensely fascinating character of the problems encountered.

I believe that the successful solution of several problems in aviation medicine will determine in large measure the outcome of the present war.

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THE PROBLEM OF THE EXPANDING UNIVERSE[1]

By Dr. EDWIN HUBBLE

MOUNT WILSON OBSERVATORY

MATHEMATICS deals with possible worlds, with the infinite number of logically consistent systems. Observers explore the one particular world we inhabit. Between stands the theorist. He studies possible worlds but only those which are consistent with the information furnished by the observer. In other words, theory attempts to segregate the minimum number of possible worlds which must contain the world we inhabit. Then the observer, with new factual information, reduces the list still further. And so it goes, observation and theory advancing together toward the common goal of science, the structure and behavior of the physical universe in which we live.

The relation is evident in the history of cosmology. The study at first was pure speculation. But slowly, as the exploration of space moved outward, a body of positive knowledge was assembled which regimented the speculation. The explorations were once confined to the system of the planets. Then, about a century ago, they reached a few of the nearest stars, and, thereafter, ranged through the stellar system. Finally, in our own times, the explorations pushed beyond the stars and swept through the realm of the nebulae, out to the extreme limits of the telescopes. To-day we study a volume of space so vast and so homogeneous that it may represent a fair sample of the universe.

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[1] Abstract of annual Sigma Xi address before the American Association for the Advancement of Science, Dallas, Texas, December 30, 1941.

The observable region is a sphere about 1,000 million light years in diameter, throughout which are scattered 100 million nebulae, each a stellar system, comparable with our own system of the Milky Way. These nebulae average about 100 million times brighter than the sun, and several thousand million times more massive. The nebulae are scattered singly, in groups and in clusters but, when large volumes of space are compared, these minor irregularities are not important. On the grand scale, our sample of the universe is approximately homogeneous—very much the same everywhere and in all directions. The smoothed-out average distance between neighboring nebulae is about two million light years, and the intervening space is sensibly transparent.

Another general characteristic of the sample is the law of red shifts. Lines in the spectra of distant nebulae are always found to the red of their normal positions, and these red shifts are directly proportional to the distances of the nebulae—the more distant the nebula, the larger the red shift. The red shifts are frequently explained as velocity shifts (Doppler shifts), indicating actual recession of the nebulae at the rate of about 100 miles per second for each million light years of distance. The phenomenon has been observed out to about 240 million light years where the apparent velocities are nearly 25,000 miles per second. It may be stated with confidence that red shifts either are velocity shifts or they must be referred to some hitherto unrecognized principle in nature.

With this preliminary sketch in mind, let us now turn to the theoretical approach to the problem. Modern cosmological theory attempts to segregate the possible worlds which are consistent with two fundamental principles, general relativity and the cosmological principle. General relativity asserts that the geometry of space is determined by the contents of space. Space is "curved" in the vicinity of matter, and the amount of curvature depends upon the quantity of matter. If the large-scale distribution of matter in the universe is approximately uniform, we may assume a constant curvature or, as it were, "spherical" space. Local irregularities may be disregarded just as mountains and ocean basins are disregarded when we speak of the spherical surface of the earth. The cosmological principle is the simple assumption that there is no favored position in the universe, no center, no boundary. The large-scale aspects of the universe will appear much the same from whatever point they are inspected. This principle implies homogeneity and isotropy.

Possible universes, consistent with the two principles, are found to be unstable. They might be in momentary equilibrium but the balance could not persist. In general, these universes would be either contracting or expanding. At this point, the theorist turns to observations, and accepts the red shifts as visible evidence that our universe is expanding at a rapid rate. Thus arose the concept of homogeneous expanding universes of general relativity.

The problem now passes to the observer. He attempts first to test the assumptions on which the theory is founded and, second, to assemble new information which will identify, among the limited number of possible types, the universe we actually inhabit.

Investigations of this nature have been made during the last five or six years. On the one hand, the assumption of large-scale homogeneity has been reexamined by precisely controlled counts of nebulae to successive limits of apparent faintness. On the other hand, attempts have been made to determine empirically whether or not red shifts do represent actual recession.

The assumption of homogeneity appears to be fairly well established both by deep sampling surveys made at the Mount Wilson and the Lick Observatories, and by those portions of the later counts made at Harvard which are adequately calibrated. If the observable region were divided into a thousand equal parts, their contents would probably be sensibly the same.

The question of red shifts may be examined by means of the dimming effects of recession. A rapidly receding nebula will appear fainter than a similar but stationary nebula at the same momentary distance. The stream of light quanta from the receding nebula is thinned out, and fewer quanta reach the observer each second. Since the rate of impact of the quanta measures the apparent brightness, the receding nebula appears fainter than it would if it were stationary. The dimming factor—the factor by which the normal stationary luminosity is reduced—is merely the velocity of the nebula divided by the velocity of light or, in other words, the red shift expressed as a fraction of the normal wave-length of the light observed. Thus the dimming factor is negligible for the nearer nebulae but reaches about 13 per cent. at the greatest distance reached by the spectrograph, and, presumably, more than 25 per cent. at the limits of direct photography with the 100-inch reflector.

Since we know the intrinsic luminosity (or candle power) of nebulae, the dimming effect could be readily detected if we knew the precise distances of very remote nebulae. At present, however, such distances are estimated from the apparent faintness itself, which we wish to use for the test. Therefore the direct search for dimming factors ends in a vicious circle.

An indirect approach to the problem is still possible. Apparent faintness of nebulae furnish reliable, statistical distances on two different scales, depending upon whether the dimming factors are included or omitted. Thus we analyze our observational data, determine the precise form of the law of red shifts and the large-scale distribution of nebulae, using first one scale of distance, and then the other scale. The correct scale should lead to a consistent picture of the observable region, while the wrong scale may lead to contradictions or at least to serious difficulties. The procedure has been carried out, and one scale does seem to lead to difficulties. That scale is the one which includes the dimming factors.

If the dimming factors are omitted, the law of red shifts is sensibly linear. In other words, each unit of the light path contributes the same amount of red shift. Furthermore, the large-scale distribution of nebulae is approximately homogeneous. Thus the assumption that red shifts are not velocity shifts but represent some hitherto unknown principle operating in space between the nebulae leads to a very simple, consistent picture of a universe so vast that the observable region must be regarded as an insignificant sample.

On the other hand, when the dimming factors are applied, the scale of distance is necessarily altered. The law of red shifts is no longer linear and the large-scale distribution is no longer homogeneous. These new features specify a particular type of expanding universe but one so small and so young that we hesitate to accept it as the universe we actually inhabit.

The law of red shift is altered in the sense that velocities of recession increase more and more rapidly with distance. Since light we observe to-day left the very remote nebulae far back in past ages, hundreds of millions of years ago, we must conclude that the rate of expansion of the universe has been slowing down. This result is disconcerting.

The present distribution of red shifts could be adequately described on the assumption that all the nebulae were once jammed together in a small volume of space. Then, at a certain instant, about 1,800 million years ago, an explosion occurred, the nebulae rushing outward in all directions and with all velocities. To-day, of course, we find the nebulae distributed according to their initial velocities, those moving most rapidly have reached the greatest distances, while the laggards are still in our vicinity.

Although this picture is over-simplified, it suggests the importance attached to the so-called "age of the universe"—1,800 million years. If the rate of expansion has been diminishing, if the initial velocities have been slowing down, the "age of the universe" must be still further shortened, probably to less than 1,000 million years. Such an interval is a brief moment on the cosmic time scale; it is but a fraction of the age of the earth and is even less than the history of life on the earth. Thus the universe, if it is expanding, is very young indeed—improbably young.

Equally disconcerting results are derived from the studies of nebular distribution. If dimming factors are included, the new scale of distance eliminates the apparent homogeneity. The density, that is the number of nebulae per unit volume of space, increases systematically with distance, in all directions. Such a distribution is not only improbable but it violates the cosmological principle—it suggests that the earth is in a favored position. Therefore, we must assume that the departure from homogeneity is not real but only apparent, and then find a satisfactory explanation.

The only available explanation is a positive spatial curvature which, by a sort of optical foreshortening, would introduce an apparent crowding together of nebulae in a really homogeneous universe. Thus, if the universe is expanding, it is presumably a closed universe of finite volume. Furthermore, the amount of curvature necessary to restore homogeneity is quite large; it leads to a universe so small that we already observe a sensible fraction, perhaps one fourth, of the total volume. Finally, the curvature implies a density of matter in space much greater than can be reasonably accounted for by the observed nebulae alone.

Thus the empirical studies of the law of red shifts and the large-scale distribution of nebulae lead to a dilemma. Red shifts are due either to recession of the nebulae or to some hitherto unrecognized principle operating in internebular space. The latter interpretation leads to the simple conception of a sensibly infinite homogeneous universe of which the observable region is an insignificant fraction.

The alternative interpretation of red shifts as velocity shifts leads to a particular type of an expanding universe which is disconcertingly young, small and dense. Moreover, the strange features of this universe are merely the dimming effects of recession expressed in other terms. Under these circumstances, the inclusion of the dimming factors seems to be a questionable procedure. In other words, the empirical evidence now available does not favor the interpretation of red shifts as velocity shifts.

Two further points may be mentioned. In the first place, the conclusion has no vital effect upon the theory of expanding universes; it merely removes the theory from contact with observations. If red shifts do not represent actual motion, we may still assume that our universe is either contracting or expanding at a rate that can not now be measured by the observer.

In the second place, the conclusion assumes that the measures on which they are based are reliable. They are all the measures we have which bear on the critical questions and, by the usual criteria of probable errors, they seem to be sufficiently consistent. Nevertheless, the operations are delicate, and the most significant data are found near the extreme limits of the greatest telescopes. Under such conditions, it is always possible that the results may be affected by hidden systematic errors, the nightmare of all observers. This possibility will persist until the critical investigations can be repeated with improved techniques and more powerful telescopes. Ultimately, the matter should be settled beyond question by the 200-inch reflector destined for Mount Palomar.

Meanwhile, on the basis of the evidence now available, a choice seems to be presented, as once before in the days of Copernicus, between a small, finite universe, and a sensibly infinite universe plus a new principle of nature. And, as before, the choice may be determined by the attribute of simplicity.

OBITUARY

SOMA WEISS

DR. SOMA WEISS, of Cambridge, Massachusetts, died suddenly on January 31, 1942, after a brief illness, just having passed his forty-third birthday. At the time of his death he occupied two nationally important medical posts: he was the eighth physician to be Hersey professor of the theory and practice of physic in Harvard University, and the second to be physician-in-chief of the Peter Bent Brigham Hospital in Boston.

He was born in Bestercze, Hungary, but came to the United States as a young man. He graduated from Columbia University in 1921 with the degree of bachelor of arts, and received his medical diploma from Cornell University in 1923. But before this, already he had displayed ability as a teacher and student at the Royal Hungarian University at Budapest, where he served as demonstrator and research fellow in physiology and biochemistry. From the very outset of his career, therefore, he displayed an interest in these two fundamental sciences, and this persisted. He seemed to ask himself continually how things pertaining to medicine happened and how they might be influenced by physiologic and chemical approaches.

In 1925, the Harvard Medical School was able to attract him to Boston by appointing him research fellow in medicine. The opportunities for the investigation and study of disease afforded by the Thorndike Memorial Laboratory of the Boston City Hospital were bound to appeal to a man of his ideals, and here he worked until 1939. His career there served well to illustrate the qualities of imagination and industry which were so prominent in his make-up.

In the Boston City Hospital, he rose from research fellow to assistant director of the Thorndike Memorial Laboratory and physician-in-chief of the Fourth Medical Service—no mean achievement in the course of eleven years for a stranger to Boston. As he grew accustomed to Boston and its medical ways, and as he grew older, besides becoming a master clinician and investigator, he developed also remarkable skill in inspiring men younger or older than himself to learn more: medical students, interns or colleagues. These abilities were so impressive that he ascended the academic ladder of Harvard with equal promptness. He started as an assistant in the department of medicine and became associate professor seven years later.

During the years at the Boston City Hospital, his industry bore fruit in many ways: The patients liked him, for his conscience never allowed him to forget that the patient in the hospital was a human being who might be, like any one else, homesick or lonely, ill in mind as well as body; his colleagues on the staff of the hospital admired and respected him, for he was easy to deal with, unselfish and always honest and straightforward; his students adored him. Whenever he made ward rounds, there would be an enthusiastic following; and one of the important teaching exercises which he conducted with painstaking regularity was that of meeting the house officers of the entire hospital one evening each week, when he would visit other wards than his own and discuss medical problems with others than his own group.

His pen was busy constantly; well over a hundred papers were written during his Boston City Hospital years; and they cover a wide range of subject-matter. They were written only as a man with scientific conscience allows himself to write—always with a careful analysis of what other workers had done previously on the problem under discussion, an account of what his own observations entailed and what he believed they added. To work and teach as he did required not only remarkable industry but also omnivorous reading. On top of all this, he found time to take a sincere interest in various scientific medical societies—the American Association for the Advancement of Science, the American College of Physicians, the American Heart Association, the Association of American Physicians, the Association of Research in Nervous and Mental Diseases, and many others.

In 1938, when the Peter Bent Brigham Hospital needed to appoint a new physician-in-chief, and when

Harvard University needed a new Hersey professor of the theory and practice of physic to succeed Dr. Henry A. Christian, Dr. Weiss seemed an obviously satisfactory choice. So it came about that Dr. Weiss moved from the Thorndike Memorial Laboratory and the Boston City Hospital to the Peter Bent Brigham Hospital and was promoted to one of the most venerable medical professorships in the country.

Two and a half academic years in the life of a university or hospital are not long. Yet, Dr. Weiss will be remembered by Harvard University as having carried forward honorably the fine tradition upheld by his predecessors in the Hersey professorship of the theory and practice of physic; and at the Brigham Hospital, he will be regarded as are Francis Peabody, Harvey Cushing and Henry Christian. For, like them, he did his share to make of this hospital an institution such as the donor wished—a sanctuary where life would be more hopeful and care more possible for sick persons in indigent circumstances residing in the County of Suffolk and for sick persons the world over.

REGINALD FITZ

DEATHS AND MEMORIALS

DR. GLOVER MORRILL ALLEN, associate professor of zoology at Harvard University and curator of mammals at the Agassiz Museum, died on February 14, at the age of sixty-three years.

PROFESSOR FRED W. UPSON, dean emeritus of the Graduate College of the University of Nebraska and a former chairman of the department of chemistry and chemical engineering, died on February 10.

ACCORDING to *Chemical and Engineering News*, as a memorial to E. P. Kohler, professor of chemistry at Bryn Mawr College until 1912 and at the time of his death in May, 1938, Sheldon Emery professor of organic chemistry at Harvard University, a fellowship for graduate study in chemistry has been endowed through contributions from his students. Recipients of the fellowship will be chosen in such a way as to provide for an exchange of outstanding students between the institutions where Kohler taught and those in which the Kohler tradition is particularly cherished.

SCIENTIFIC EVENTS

EXPEDITIONS OF FIELD MUSEUM OF NATURAL HISTORY

FOUR of the five expeditions which Field Museum of Natural History has in Latin-American countries have recently sent to the museum reports on the progress of their work.

Paul O. McGrew, assistant curator of paleontology, who is leader of an expedition in Honduras, reports that he has excavated a specimen of a large and rare dog which lived some 7,000,000 years ago and is similar to a rare type of about the same period that inhabited the North American plains. He has found also a dwarfed type of Pliocene horse which resembles prehistoric North American horses in all characters except size. Its stunted growth may have been due to the unfavorable habitat afforded by the tropics. He writes that the dog is a species almost "certainly new to science, and of great importance." He also writes: "I am amazed and pleased at the high opinion in this country of anything pertaining to 'Los Estados Unidos.'"

Colin Campbell Sanborn, curator of mammals, who is conducting a zoological expedition in Peru, reports that he has collected a large number of animals for the museum. He is engaged in visiting localities of special zoological interest, especially in the valleys of some of the more remote tributaries of the Amazon.

From Cuenca, Ecuador, Donald Collier, ethnologist, sends a preliminary report on explorations on muleback in little-known regions, and archeological excavations on sites once the seats of prehistoric Indian communities. The museum shares in this expedition with the Institute of Andean Research, New York.

Dr. Julian A. Steyermark, who is conducting a botanical expedition in Guatemala, is working in difficult mountain regions and living largely with native Indians.

The museum's fifth Latin-American expedition, that being conducted by Llewelyn Williams, curator of economic botany, who is making a botanical survey in Venezuela, has not reported recently.

DEDICATION OF THE HORACE H. RACKHAM EDUCATIONAL MEMORIAL

THE Horace H. Rackham Educational Memorial of the Extension Service of the University of Michigan and the Engineering Society of Detroit was dedicated on January 28. The building was made possible by gifts to the university and to the society from the Horace H. Rackham and Mary A. Rackham Fund and from Mary A. Rackham. It was erected at a cost of $2,000,000 and is situated in the art center of Detroit.

President Alexander G. Ruthven accepted the building for the university. He pointed out that the facilities of the university wing of the memorial will be used to meet the educational needs of two groups, young people who are unable to spend years of continuous study at Ann Arbor and adults who desire to continue their education. He said:

No one with the ability to carry on advanced studies should be denied the opportunity through the accident of financial responsibility to pay the cost of the regular college courses. It is not expected that this unit will ever become a branch of the parent institution, extensively duplicating the educational facilities in Ann Arbor. The plan will be to offer here courses most in demand with the thought that they will serve the need both of those who seek merely a limited amount of training beyond the high-school level.

The two wings of the building, which is of white limestone, are owned separately by the university and the engineering society. They flank a central section which contains an auditorium with a seating capacity of 1,000 and a large banquet hall, both of which are available to either institution.

The facilities of the engineering unit include a dining room, a small auditorium, large lounge and social rooms, a library, meeting rooms for the seventeen affiliated societies of the society and offices for the executive staff.

Twenty-one classrooms in the university unit are capable of accommodating approximately 1,000 students at one time. Special classroom facilities are provided for radio and specialized speech courses, science, mathematics, engineering and the social sciences. There is in the central section a spacious library, which will be conducted as a branch of the general library of the university and which overlooks the Detroit Institute of Arts and the Detroit Public Library. The university unit also provides office and classroom space for the graduate curriculum in social work of the Institute of Public and Social Administration.

It is pointed out that centralization of the program of extension courses in the Detroit area will do much to unify and expand the program of the Extension Service, which for years has offered courses in churches, schools, "Y" buildings, hotel rooms and other scattered locations. Provision of office space in close proximity to the classrooms will also simplify administrative procedures. There was an enrolment for the first semester this year of more than 3,000 students.

ADVANCED INSTRUCTION AND RESEARCH IN MECHANICS AT BROWN UNIVERSITY

CONTINUING the work offered during the summer of 1941 and the present academic year, Brown University will offer opportunity for instruction and research in mechanics and allied branches during an eleven weeks period beginning on June 15, as well as during the next academic year. During the summer the emphasis will be on preparing for the present national emergency; during the academic year, attention will be directed primarily toward a long-range program of preparation in applied mathematics for university instructors and for research workers.

To review the work of the Summer School of 1941 and to make recommendations on a nation-wide basis, an evaluating committee, composed of eminent scholars in engineering, physics and mathematics, was appointed. This committee—consisting of Marston Morse, Institute for Advanced Study, *chairman;* Theodore von Kármán, California Institute of Technology; Mervin J. Kelly, Bell Telephone Laboratories; George B. Pegram, Columbia University, and Warren Weaver, Rockefeller Foundation—in its report stressed the present need for developing a program in applied mathematics and endorsed the experiment made at Brown University. It is also aiding in shaping plans for the future.

Courses are offered for the summer of 1942 under the direction of a distinguished faculty of eight. These include Professor Leon Brillouin, Professor Willy Prager, Dr. Stefan Bergman, Professor Ivan S. Sokolnikoff, Professor J. D. Tamarkin, Professor Willy Feller, Dr. Sergei A. Schelkunoff and Professor Richard von Mises. Under another program there will be lectures directed by Professor R. B. Lindsay. In addition there will be single lectures or short series of lectures by visiting experts, some stressing the practical side and others the theoretical. During the next academic year eight courses will be offered in addition to opportunities for research. Substantial fellowships will be available for selected students.

Because this work is supported by the Engineering, Science and Management Defense Training Program of the U. S. Office of Education, the Carnegie Corporation of New York and the Rockefeller Foundation, no fees will be charged. In the summer the participants will be limited to eighty in number, of which twenty will devote their time primarily to research; during the academic year the number will be limited to forty.

Information in regard to each of these programs may be obtained from the Dean of the Graduate School, Brown University, Providence, R. I.

THE RESEARCH COUNCIL ON PROBLEMS OF ALCOHOL

IN an outline of its program of its objectives, resources and progress, the Research Council on Problems of Alcohol makes a report of researches now in progress. These are:

A critical survey of all work completed to date on the effects of alcohol on the individual—by the College of Medicine of New York University, with a grant of $25,000 from the Carnegie Corporation.

A study of toxic factors in alcoholism—by the New York State Psychiatric Institute, with a grant of $1,500 from The American Philosophical Society. Minimum value of services and facilities contributed by the institute—$2,200.

A study of the role of alcohol in liver cirrhosis—by the College of Medicine of New York University, with two grants, $2,100 and $1,500, from The Dazian Foundation for Medical Research. Minimum value of services and facilities contributed by the university—$7,200.

A study of reactions resulting from the ingestion of alcohol, for the ultimate purpose of discovering how a craving for alcohol is established—by the Phipps Psychiatric Clinic of Johns Hopkins University, with a grant of $1,800 from the council's research fund. Minimum value of services and facilities provided by the clinic—$3,750.

What happens to patients discharged as "cured" from institutions for alcoholics—by Columbia University, with a grant of $7,500 (for the first year) from the council's research fund.

The effects of maternal alcohol ingestions on the fetal cortex—by the University of Virginia Medical School, with a grant of $1,315 from the council's research fund. Minimum value of services and facilities provided by the Medical School—$500.

An informal survey of a town of 4,000 people to reveal the extent of alcoholism and the adequacy of measures now in use for its treatment—by E. M. Jellinek of the Laboratory of Applied Physiology of Yale University. This study is being carried on to provide for the experimental use of techniques being considered for a more extensive study.

GRANTS-IN-AID OF THE COMMITTEE ON SCIENTIFIC RESEARCH OF THE AMERICAN MEDICAL ASSOCIATION

THE Committee on Scientific Research of the American Medical Association has made grants-in-aid as follows:

T. T. Chen, University of California, illustrations of malarial parasites.

W. W. Cahill, Wayne University, Detroit, self-selection of food in relation to tumor growth.

Timothy Leary, Boston, Massachusetts, cost of extra illustrations in article on atherosclerosis.

Reginald Fitz, Boston, Massachusetts, the clinical beginning of hyperthyroidism.

I. M. Tarlov, Jewish Hospital, Brooklyn, plasma clot as nerve suture.

F. J. Braceland, Loyola University School of Medicine, Chicago, carbohydrate disturbances in schizophrenia.

A. M. Lassek, Medical College of the State of South Carolina, retrograde degeneration in pyramidal tract.

Charles W. Turner, University of Missouri, mechanism of lactation.

Robert P. Ball, Columbia University, roentgen pelvimetry.

A. McGhee Harvey, Vanderbilt University School of Medicine, Nashville, secretion of thymus gland.

John R. Paine, University of Minnesota, oxygen poisoning.

Hans Popper, Cook County Graduate School of Medicine, Chicago, vitamin A in tissue.

Wesley W. Spink, University of Minnesota, nutrition and immunology of staphylococci.

Oliver P. Jones, University of Buffalo, effect of antianemic principle on embryonic blood cells.

Enid Rodaniche, University of Chicago, chemotherapeutic agents on intestinal flora in infectious conditions.

Ben Vidgoff, University of Oregon, morphology of endocrine and secondary sex organs in male white rat.

Daniel J. Glomset, Des Moines, Iowa, cardiac conduction.

L. R. Cerecedo, Fordham University, New York, vitamin-B deficiency in rats and mice.

Catharine Macfarlane, Woman's Medical College of Pennsylvania, Philadelphia, periodic pelvic and breast examination.

Peter P. H. de Bruyn, University of Chicago, osteogenic substances in laying birds.

THE FIRST WESTERN MEETING OF BIOMETRICIANS

ON the initiative of Dr. C. I. Bliss, chairman of the Committee of the Biometric Section of the American Statistical Association, a committee of biologists and statisticians was appointed recently to organize a meeting of western biometricians. Such a meeting was held on the Berkeley campus of the University of California on December 29 and 31, 1941. The theme of the meeting was: "The Potential and Actual Contributions of Statistics to the Solution of Biological Problems." Sessions were held concurrently with those of the two national entomological societies whose members have shown considerable interest in applications of mathematical statistics. A joint session was held with these two groups in San Francisco on the afternoon of December 30.

The committee that arranged this first western meeting of biometricians interpreted the word biometry in a very broad sense and encouraged the attendance of biologists and mathematicians from as many fields as possible. Six separate sessions were held, each devoted to a general field. These included: (1) botany—population studies, plant breeding and genetics; (2) general biology—bacteriology, irradiation by x-rays and by neutrons; (3) mathematics—statistical techniques; (4) entomology—population studies and sampling problems; (5) forestry—growth, genetics and sampling problems.

Twenty-four papers were presented in all and many of them created lively discussions. The meeting was well attended by both biologists and mathematicians, the former predominating. This testified to the widespread interest of biologists in the application of statistical methods in their research. The growing usefulness of statistics in biology was clearly evident in the tone of the meeting. It was felt that similar western meetings called at regular intervals, perhaps conjointly with the meetings of the Pacific Coast Section of the American Association for the Advancement of Science, would be useful both to the biologists and to biologically-minded mathematicians and physicists.

At a business meeting called during the second day it was resolved to set up a permanent organization, to be known as the Western Society of Biometricians, which may become affiliated with the American Association for the Advancement of Science, with the American Statistical Association and perhaps with other organizations. A committee was elected to draw up the form of the permanent society. The members of the committee were selected to represent all fields of biology and mathematics. The following officers have been elected:

Chairman: J. Neyman (Mathematical Statistics); *Vice-chairmen:* E. B. Babcock (Genetics); R. T. Birge (Physics); E. C. Tolman (Psychology), all of the University of California, Berkeley; *Secretaries:* E. R. Dempster (Genetical Effects of Irradiation), also of the University of California at Berkeley, and A. Hormay (Range Management), California Range and Forest Experiment Station at Berkeley.

The organization of a second meeting, where the form of the new society could be discussed and voted upon, was left to this committee. In addition, the committee was directed to consider the possibilities of establishing a journal for the publishing of biological papers involving the application of mathematics to biological problems. Such a journal is needed in order to fill the gap between mathematical publications and the journals of biology. No such journal has been published in this country up to the present time. The idea of the new journal originated with the Committee of the Biometric Section of the American Statistical Association, and was heartily approved by those in attendance at the first western meeting in Berkeley. Any one interested in the new society is invited to communicate with members of the organizing committee.

SCIENTIFIC NOTES AND NEWS

THE annual general meeting of the American Philosophical Society will be held in Philadelphia on April 23, 24 and 25. The sessions on Thursday, April 23, will be devoted to a symposium on recent advances in American archeology in which fifteen leaders in that field will take part. The Franklin Medal Lecture will be given on that evening by Dr. Sylvanus G. Morley on the work of the Carnegie Institution in Central America and Mexico. Dr. James Rowland Angell will deliver the Penrose Memorial Lecture on Friday evening, April 24, on the general subject of education in a world at war.

A SPECIAL cable from London to *The New York Times*, dated February 21, reports that the Faraday Medal of the Council of the British Institution of Electrical Engineers has been awarded to Dr. Peter Kapitza in recognition of his contributions to science in the generation and utilization of intense magnetic fields. Dr. Kapitza is director of the Institute of Physical Problems at the Moscow Academy of Sciences. Formerly he was assistant director of magnetic research at the University of Cambridge.

PRESENTATION of the gold medal of the Radiological Society of North America was made at the recent San Francisco meeting to Edith H. Quimby, "in recognition of her work on dosage and filtration." Since 1932 Mrs. Quimby has been physicist at the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York.

A. B. HOEN, president of the firm of A. Hoen and Company, lithographers, Baltimore, has been elected an honorary member of the American Geographical Society of New York. The honor was conferred on Mr. Hoen in recognition of the contributions that his firm and he personally have made to the development of the science and art of fine map reproduction in the United States.

HAROLD S. OSBORNE, plant engineer in the operation and engineering department of the American Telephone and Telegraph Company, New York, has been nominated for the presidency of the American Institute of Electrical Engineers.

FRANCIS W. PENNELL, curator of plants of the Academy of Natural Sciences of Philadelphia, has been elected president of the American Society of Plant Taxonomists.

DR. FRANCIS S. SMYTH, professor of pediatrics at the Medical School of the University of California, has been appointed dean. The post has been vacant since the retirement in December, 1939, of Dr. Langley Porter.

PROFESSOR DAVID L. ARM, of the Iowa State College, has been appointed head of the department of mechanical engineering. He succeeds Mark P. Cleghorn, who will continue his work as professor.

G. M. RIDENOUR, formerly associate professor of sanitary engineering at Pennsylvania State College, has been appointed associate resident lecturer on public health engineering at the School of Public Health of the University of Michigan.

THE staff of the department of psychology of the

Louisiana State University has undergone several changes in the past few months. Dr. Wayne Dennis has been appointed professor of psychology and head of the department; Dr. James H. Elder has been appointed assistant professor of psychology to succeed Dr. Harry M. Capps, who died on January 17; Dr. Alan D. Grinsted has leave of absence while on duty as a lieutenant in the U. S. Navy.

DR. A. PACKCHANIAN, who during the last six years has been connected with the National Institute of Health of the U. S. Public Health Service, has resigned to become associated with the School of Medicine of the University of Texas at Galveston. He will continue research in bacteriology and tropical medicine.

DR. ERNEST W. REID, of Pittsburgh, who has been assistant chief, has been appointed chief of the Chemicals Branch of the Division of Materials of the War Production Board. He takes the place of Dr. Edward R. Weidlein, director of Mellon Institute, who will continue as senior consultant. Dr. Weidlein has been devoting part of his time to the branch, with his efforts centered recently on development of the synthetic rubber program. He will continue this responsibility for the Materials Division.

DR. AMOS CHRISTIE, associate professor of pediatrics at the Medical School of the University of California, San Francisco, has been appointed assistant director of medical and health service of the American Red Cross, with headquarters in Washington.

DR. ROBERT CUSHMAN MURPHY, of the American Museum of Natural History, has been elected a councilor of the American Geographical Society.

C. F. RASSWEILER, director of research of the Johns-Manville Corporation, has been appointed a vice-president of the company. He will continue in charge of research and development activities.

FOLLOWING the death of Senator Alva B. Adams of Colorado, Senator Carl A. Hatch of New Mexico was named on January 15 to take his place as chairman of the Senate Committee on Public Lands and Surveys. This committee has charge of all Senate bills relating to national parks.

PROFESSOR THEODORE H. MORGAN, head of the department of electrical engineering of the Worcester Polytechnic Institute, Worcester, Massachusetts, has been called to the U. S. Office of Education at Washington as principal specialist in engineering education. His work will involve responsibility for the administration of the educational aspects of the national engineering defense training program in colleges and universities, including the development of intensive courses designed to fit engineers for specialized positions in defense industries involving all fields of engineering. He has been granted leave of absence, and will reside in Washington.

Nature states that Sir John Russell, director of the Rothamsted Experimental Station, has been appointed adviser to the Soviet Relations Branch of the Ministry of Information. When carrying out research in the agricultural sciences, Sir John came into close contact with Soviet men of science and has traveled widely in the U.S.S.R.

NOMINATIONS to the council of the American Association of Museums for the three-year term 1942–45 have been made by the council as follows: Henry Butler Allen, director of the Franklin Institute, Philadelphia; Andrey Avinoff, director of the Carnegie Museum, Pittsburgh; Alfred H. Barr, Jr., director of the Museum of Modern Art, New York; Charles M. B. Cadwalader, director of the Academy of Natural Sciences of Philadelphia; Grace L. McCann Morley, director of the San Francisco Museum of Art; Arthur C. Parker, director of the Rochester Museum of Arts and Sciences; Laurance P. Roberts, director of the Brooklyn Museum, New York; Carl P. Russell, supervisor of interpretation, National Park Service, Washington; Paul J. Sachs, associate director of the Fogg Art Museum, Cambridge, and Alexander Wetmore, assistant secretary of the Smithsonian Institution, Washington.

DR. OTIS W. CALDWELL, general secretary of the American Association for the Advancement of Science, spoke on February 26 at 7:30 P.M. at Members Night of the American Institute, New York. His subject was "Text-book Science."

DR. ALBERT F. BLAKESLEE, of Cold Spring Harbor, N. Y., last year president of the American Association for the Advancement of Science, delivered on February 19 the annual Phi Beta Kappa lecture at the College of Wooster on "Personality in Relation to Science and Society." He also addressed the students on "The Scientific Method in Every-day Life," and spoke to the staff of the Ohio Agricultural Experiment Station and a genetics group at the college on "Control of Evolution in Datura."

THE seventh annual Hughlings Jackson memorial lecture of the Montreal Neurological Institute will be given on February 27 by Dr. Edgar D. Adrian, professor of physiology at the University of Cambridge, Nobel laureate in medicine in 1932. He will speak on "Sensory Areas of the Brain."

DURING the period from February 23 to March 14, Dr. P. W. Bridgman, Hollis professor of mathematics and natural philosophy at Harvard University, is delivering Sigma Xi lectures dealing with the problems and techniques of high pressure at the following institutions: the Iowa State College, the University of Minnesota, the University of Wisconsin, Purdue University, the University of Cincinnati, the Carnegie Institute of Technology, the University of Illinois, the Ohio State University, the Pennsylvania State College, Swarthmore College, Rutgers University, Yale University, the University of North Carolina, the Louisiana State University, Tulane University, the University of Texas and the Rice Institute.

A series of three public lectures entitled "Our Ancestors, Ourselves, Our Descendants" has been arranged at the Woman's Medical College of Pennsylvania. On January 23, Professor R. Ruggles Gates, of the Marine Biological Laboratory at Woods Hole, Mass., delivered the first lecture. Professor Laurence H. Snyder, of the Ohio State University, will give the second lecture on March 27, and Professor Earnest A. Hooton, of the department of anthropology of Harvard University, will give on April 24 the last lecture.

A series of fourteen Thursday evening seminars on "Biologically Active Substances" will be conducted this winter at the Physiological Laboratories of Clark University. Those in charge of the seminars are: Dr. Kenneth Thimann, Harvard Biological Laboratories; Dr. Gregory Pincus, Clark Physiological Laboratories; Dr. E. B. Astwood, Harvard Medical School; Dr. Arturo Rosenblueth, Harvard Medical School; Dr. G. H. Parker, Harvard Biological Laboratories; Dr. Valy Menkin, Harvard Medical School; Dr. George Wald, Harvard Biological Laboratories; Dr. Mark Graubard, Clark Physiological Laboratories; Dr. Elmer Stotz, Harvard Medical School; Dr. Kurt Stern, Yale Medical School; Dr. Hudson Hoagland, Clark Physiological Laboratories; Dr. Robert S. Harris, Massachusetts Institute of Technology; Dr. H. J. Muller, Amherst College; Dr. M. L. Anson, The Rockefeller Institute.

The Civil Service Commission is seeking metallurgists for work in Government navy yards, arsenals and other war agencies. The positions pay from $2,000 to $5,600 a year and will last in most cases for the duration of the war. Sending application forms, obtainable in any first- or second-class post office, to the Commission in Washington, D. C., is all that is necessary to be considered for these positions. Experience in metal-working industries with fabrication processes such as welding, die-casting, heat treating, x-ray testing and metallographic work is particularly desired, but not necessary for all positions. College training in metallurgy or college training in other subjects and one y qualify for positions pa higher salaried positions, some or graduate study, in addition to a b is required. The positions are in Washingto and in Government war establishments through the country.

Alumni of Bucknell University have organized the Bucknell Alumni Research Foundation and have incorporated it as a non-profit organization. Its immediate purpose is to utilize the results of the researches of Dr. William H. Eyster, who has been made research professor of genetics. Dr. Eyster will, in the future, devote most of his time to a study of the genetics and breeding of economically important food and ornamental plants.

The third annual symposium of the Society for the Study of Growth and Development was advertised in Science of January 2 as $3.00 to members of the society. The price should have been $3.00 to nonmembers of the society. Members, of course, receive a copy free.

The eighty-first national meeting of the Electrochemical Society will be held at Nashville, Tenn., from April 15 to 18. Plans for the meeting are being carried out by Professor J. M. Breckenridge and his committee. There will be two symposia, one on "Electric Furnace Reactions," in charge of Dr. John D. Sullivan, of Battelle Institute, Columbus, and the other on "Corrosion," in charge of Dr. R. M. Burns, of the Bell Telephone Laboratories, New York City.

The Midwestern Psychological Association will hold its seventeenth annual meeting at Hotel Statler, St. Louis, Mo., on Friday and Saturday, May 1 and 2, under the presidency of Dr. J. P. Porter. The title of his presidential address will be "Psychology and the Functional Integration of Human Behavior." The members of the department of psychology at Washington University will act as hosts, with Dr. J. P. Nafe as chairman of the local committee. On account of the considerable distance of the university from housing facilities, all meetings will be held at Hotel Statler, the headquarters.

The Association of Southeastern Biologists will hold its sixth annual meeting at Miami, Fla., April 16, 17 and 18, with the University of Miami as host. The official hotel will be the Antilla, Coral Gables, at $1.50 per day. The president, A. S. Pearse, Duke University, will address the association on marine biology in the Southeast. The first day of the meeting will be devoted to a marine trip and a field trip to the Everglades. Information regarding the trips can be obtained from Professor Jay F. W. Pearson, of the

University of Miami. Abstracts of papers to be presented must be filed with the secretary, Donald C. Boughton, U. S. Regional Laboratory, Auburn, Alabama, not later than March 31.

THE second American Congress on Obstetrics and Gynecology, sponsored by the American Committee on Maternal Welfare, will be held in St. Louis from April 6 to 10. The program will include general assemblies and individual group meetings on medical, nursing, public health and institutional administrative problems relating to the factual and scientific aspects of maternal and infant care.

DISCUSSION

A YEAR IN AN AMERICAN UNIVERSITY

IT is always with the greatest of pleasure that I recall the time I spent in the United States in 1928–29 as a visiting professor of colloid chemistry in the University of Wisconsin, Madison. Madison is a charming little town lying in the midst of the golden fields of the Middle West and surrounded by numerous lakes and forests. The locality strongly resembles that of the Valdai Hills or Lake Seliger, the favorite vacation spots of the residents of Moscow and Leningrad.

Almost the whole of Madison is permeated with the life of the university, and the university grounds are the real heart of the city. There are many such towns in England and Holland, and once Germany, too, had such towns, but that was before the tempest of madness dispelled the traditions of German learning.

Particular attention was concentrated on colloid chemistry in the University of Wisconsin, and this chair was occupied in turn by a number of professors invited from other universities and even from other countries. Nowhere is this excellent form of international scientific collaboration practiced so widely as in the United States. Besides teaching, I had the opportunity, while in Madison, of engaging in certain experimental researches on various problems of electrochemistry. What especially amazes the foreigner in an American laboratory is the ability to get along with a very small service staff and with a modest supply of apparata and reagents. The necessary orders are put through without any formalities and thanks to the high level of the American laboratory supplies industry and the fact that standard spare parts for instruments are always on sale, these orders are very easily filled. American students very quickly grasp and carry out the idea of experimental work, for they come of a people accustomed to automobiles and radios from childhood.

Another attractive feature of the University of Wisconsin was its democratic traditions and the interest its members showed in the Soviet Union. Every new person I met followed up the traditional first question, "How do you like this country?" with questions concerning the life of the Soviet Union, its organization and aims. The American does not put these questions in a general form. On the contrary, he tries to build up a picture for himself on the basis of concrete details. I remember that when I was asked to speak on the Soviet Union at the faculty of the chemistry department the questions put to me sometimes concerned minor everyday matters, which, however, helped the audience form a tangible idea of life in the Soviet Union.

In general the year I spent in Madison is one of the most pleasant years of my life. The only thing that worried me at first was the fear that my English would be unintelligible to my students. These fears, however, were soon dispelled; as explained to me with the characteristic outspokenness of the American students, since I always made the same mistakes my hearers soon readily grew accustomed to them.

My year in Madison also gave me the opportunity to visit a number of other American universities and laboratories and to become acquainted with many prominent American chemists. In the General Electric laboratories in Schenectady I had the great pleasure of meeting Dr. Irving Langmuir, who, in my opinion, has had more influence than anybody else on the modern development of physical chemistry. Especially that field which has taken most of my attention, the study of surface phenomena, is endlessly indebted to the brilliant and versatile gifts of this scientist. I remember very well how, at the beginning of my career, I used to impatiently await every new work of Langmuir's. The last time I saw his signature under a printed text was but a few weeks ago. It stood under an appeal addressed by American scientists and writers and calling for a fight against Nazism.

At the invitation of Professor J. W. McBain, I delivered a lecture at Stanford University, amidst the cactuses and palms of California. We had a long discussion then about the structure of surface layers, but just now I should like to remember Professor McBain not only as an outstanding scientist but as a man who has given a great deal of effort to consolidating the ties between American and Soviet science. On my way back to Moscow from America I stopped in Berlin. This was in the summer of 1929. German science was still in existence then, and on the quiet streets of Dahlem people spoke of scientific theories and new discoveries and not of killing and destruction. In the Kaiser Wilhelm Institute für physikalische Chemie, directed by the famous Friedrich Haber, I met Professor N. Freundlich, from whom we all more or less learned colloid chemistry. He invited me to remain and work awhile in Germany, but I was in a hurry to get home.

All this now seems to be a dream from long ago. Haber and Freundlich have died in exile. The Germany of to-day does not offer us joint scientific work but the destruction of our cities and the physical extermination of their populations. All our thoughts are turned to the assistance of our country. And in this fierce fight which we are waging for ourselves and for all humanity, we are glad to know that we have behind us all the might of the great American nation.

A. Frumkin

NEON LIGHTS

In the December 19, 1941, issue of Science, there appears a note entitled "Extra Strong Heliotropic Effect of Neon Lights." The writer points out that insects have been observed to collect around neon lights to a greater extent than around "white lights." He then suggests that the "neon lights may emanate invisible rays which connect with the antennae of various insects and pull them to its source." The belief is implied that the insect eye is sensitive only to visible radiation, that is, wave-lengths to which the human eye is sensitive (approximately 3,900 to 7,200A).

Experiments by Bertholf on the honey-bee[1] and *Drosophila*[2] show that in these two insects sensitivity to wave-lengths in the near ultraviolet is far greater than sensitivity to those wave-lengths visible to the human eye. The sensitivities of these insects have maxima near 3,600A several times the sensitivity to any wave-lengths in the visible; and there is general high sensitivity between 3,000 and 4,000A. The spectrum of neon shows a number of strong lines in this region, whereas the spectra of tungsten filament lamps, presumably the source referred to as "white lights" by the writer, is weak in this region. Even without an estimate of relative intensities one might expect that these insects, both of which are positively oriented by light, would collect in greater concentration about neon lamps than about tungsten filament lamps. It is reasonable to assume that the eyes of many other insects have spectral sensitivities similar to those of the honey-bee and *Drosophila* and would behave in similar fashion. Lacking complete knowledge on this point and with no estimate of the relative intensities of the sources, no final explanation of the writer's observation can be given, but there seems no reason to postulate that any organ other than the insect eye is involved.

It seems appropriate to call attention here to the fact that many interpretations of behavior of lower organisms have been based on the assumption that their light receptors are strictly comparable to the eyes of man. Accurate information on the photoreceptors of invertebrate organisms is more scanty than could be desired, but, nevertheless, many instances of mystifying behavior of organisms in light fields may be quite simply explained if spectral sensitivity and visual acuity are taken into account.

Harold F. Blum

National Cancer Institute,
National Institute of Health,
U. S. Public Health Service

GALENA IN CONCRETIONS OF POTTSVILLE AGE

The writer is interested in the article written by Alfred C. Lane in the issue of Science of November 14, 1941, concerning the occurrence of galena in sedimentary rock. Lane calls our attention to the fact that sedimentary galena from Joplin, Mo., has a relatively high proportion of isotopes which may be of radiogenic origin. He urges that galenas from sedimentary formations be collected and kept for further scientific research, and the Committee on Measurement of Geologic Time be informed about it.

Near Marshallville, Ohio, in a railroad cut near that village, is an excellent exposure of the unconformity between the Mississippian sandstone and the basal Pennsylvanian, known as the Pottsville. Not far above the unconformity, in a black, bituminous, thinly laminated shale, occur numerous clay iron-stone concretions of the septarian type. These contain an association of minerals similar to that in the lead and zinc deposits of the Mississippi Valley. In addition to galena are found sphalerite, barite and pyrite. Sphalerite occurs in greatest abundance and barite is quite common. Galena is rare in occurrence and it required the cracking of large numbers of concretions to find one crystal, which is embedded in the concretion and measures about one quarter inch long and one eighth inch wide.

Karl Ver Steeg

College of Wooster

A PURE NITROGEN NATURAL GAS WELL

What is believed to be the first pure nitrogen natural gas well ever to be discovered in the United States, in so far as the writer has been able to ascertain, has been discovered at a shallow depth in eastern Wyoming, during the past season.

In the course of drilling a well for water on the

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[1] L. M. Bertholf, *J. Agric. Research* (1931) 42, 379; 43, 703.

[2] L. M. Bertholf, *Ztschr. vergleich. Physiol.* (1933) 18, 32.

W. H. Cross ranch, near the southern rim of the Powder River Basin, at a depth of only 156 feet, the bit penetrated a sand member containing a non-inflammable gas, under considerable pressure, so the well was shut down for a check and testing.

Warren D. Skelton, Wyoming state mineral supervisor, took a sample of this gas, and turned it over to the U. S. Geological Survey testing laboratory, in Casper, Wyoming. The analysis made by J. G. Crawford, chemist there for the Geological Survey, shows this sample to be 100 per cent. pure nitrogen gas. In a letter concerning this unusual occurrence to the writer, Mr. Skelton states: "I am certain the sample was in good shape for analysis when taken, as the gas was allowed to flow through the tube for some time before the connections were closed and the sample taken confined."

The official report furnished to me by the state mineral supervisor shows that this nitrogen gas developed a rock pressure of eleven pounds in ten minutes. As the top of the sand was barely penetrated, according to information furnished by the drillers, it is probable that this does not represent the total rock pressure present here. It has been the writer's observation that actual top pressures may take much more time than this to develop, with other natural gas wells of relatively low pressures, even when the sands have been fully penetrated by the drilling bit, particularly where such sands tend to be "tight," *i.e.*, of low porosity, or partially cemented up. Consequently, a considerable pressure of this nitrogen gas may be present in this formation and locality. The well was shut down and closed.

Because of the possible use of this remarkable natural gas for present war emergency purposes, it seems important to call general attention to its existence at this time.

HAROLD J. COOK,
Consulting geologist

AGATE, NEBRASKA

ADVERTISEMENTS IN SCIENCE

I HAVE just received the issue of SCIENCE for February 6, 1942. I wish to raise again a question of which I spoke once before, namely the small amount of report and discussion of the scientific matters of the annual meeting and the large amount of advertising.

I check 23 pages of reports and accompanying discussions, and 65 pages of advertising. The reports and discussions are preceded by a little more than half of the advertising. When I first picked up this issue its size gave me the impression that we would have a more than usually full account of the meetings. Examination showed that my first impression was decidedly wrong. Indeed, as I turned the pages looking for the reports, I was disturbed and much disappointed in being forced to the conclusion that the science meetings, so far as the reports go, are merely the agencies for carrying a huge amount of paid-for advertising. I am fully aware that the advertising is what pays mostly for the publication, as well as for profits beyond costs. Although the magazine is the property of the editor it is listed as an official organ of the American Association for the Advancement of Science and undoubtedly many members think of the American Association for the Advancement of Science and the magazine as closely related in policies. Hence my brief comments from which I omit a good many points which occur to me.

OTIS W. CALDWELL

As Dr. Caldwell's point of view may be shared by other members of the American Association for the Advancement of Science, it seems desirable to give an explanation of the situation. SCIENCE issues one special number a year and selects the one containing the report of the annual meeting of the association which is sent to all members of the Association and to some scientific men who should become members. Consequently, the issue for February 6 had a circulation of 30,000 copies.

This provides an attractive opportunity to publishers of scientific books, makers of scientific instruments and dealers in scientific supplies to reach practically all the scientific men of America through the insertion of a single advertisement. If such an advertisement were inserted in each of the special scientific journals the cost would be perhaps fifty times as much. There is no advance in charges for advertisements in the special issue, which has twice the usual edition. Consequently, profits to the journal are much smaller than in the regular issues. It is an opportunity for advertisers to come in contact with scientific men and to demonstrate their interest in research work. The special issue of SCIENCE is welcome to scientific men for the report of the annual meeting of the association and because the advertisements are of interest to them. The number can be kept through the year as a summary of the work done and as a directory of what is being accomplished by publishers and manufacturers to cooperate in work for the advancement of science. For this end publications and apparatus are as essential as the work of scientific men.

The special issue contains the same number of reading pages as the regular issues of the journal, which prints two volumes a year of about seven hundred pages each. In 1940 the number of pages of reading matter in the first volume was 704; in the second volume it was 698. This is equal to the contents of twenty books which might sell for three dollars each. Members of the American Association pay three dollars for the annual subscription. There are but few journals—perhaps no scientific journals—of the size of SCIENCE that are supplied at such a moderate rate. The subscription to *Nature* is £4"10s"0d.

The expenses of SCIENCE, according to the audit report of 1940 (the report for 1941 is not yet ready), adding $10,000 as the estimated value of the editorial work, are $68,439. In 1941 there were 15,185 subscribers, making the cost of supplying the journal to each subscriber $4.51. It is possible to supply the journal to members of the association for three dollars each only on account of libraries and other subscribers who pay the regular subscription price of $6.00, and principally on account of receipts from advertising, which in 1940 amounted to $33,297.

These advertisements are not only of value to advertisers, but are also useful to readers of the journal. One of the most distinguished scientific men in America paid a doubtful compliment to SCIENCE by writing that he found the advertisements the most interesting and useful part of the journal. Great care is taken by the editor to admit to the advertising pages only announcements that are regarded as promoting the advancement of science. Not only does SCIENCE contain no advertising of tobacco and liquors, but there are no announcements of automobiles and other products of scientific invention which might be regarded as of interest to scientific men. Every effort is used to make the advertisements informative and not primarily competitive. Advertisements are not accepted that make extravagant claims, and advertisers cooperate with the journal in presenting their announcements in a scientific and dignified form, such as is in place in a journal such as SCIENCE.

SCIENCE has been the official journal of the American Association for the Advancement of Science since 1900; during this period the membership of the association has increased from about 1,200 to more than 23,000. Since the agreement of 1938, SCIENCE has been the property of the association, though the present editor retains control until he dies or voluntarily relinquishes it. The control will then be taken over by the association and will rest in the hands of members of the executive committee and of the council. Like the present editor they will doubtless realize the importance for the advancement of science in America of intimate and cordial relations between scientific workers and those who publish their work and those who supply them with the necessary apparatus and supplies. Scientific progress is the joint product of research men and manufacturers. This is notably the case in the great industrial laboratories on whose knees lies the future of science and civilization.

EDITOR

SCIENTIFIC BOOKS

RESEARCH AND STATISTICAL METHODOLOGY

The Second Yearbook of Research and Statistical Methodology Books and Reviews. Edited by Oscar Krisen Buros. xxii + 383 pages. Highland Park, New Jersey: The Gryphon Press. 1941. $5.00.

IN 1625 Francis Bacon, in his essay "Of Studies," wrote: "Some books are to be tasted, others to be swallowed, and some few to be chewed and digested; that is, some books are to be read only in parts, others to be read, but not curiously, and some few to be read wholly, and with diligence and attention." Had he lived to-day, he might have added that some books ought not to be read at all. At no time in the past has there ever been such a need for guidance in selecting books for reading, study or reference. Presumably, book reviews are written to provide such advice. If this is the case, then a reviewer is placed by his role in a position of trust; especially when his prominence is such as to give special importance to his opinions. It is regrettable, therefore, when prominent individuals write inconclusive reviews of books the subject-matter of which is well within the domain of their proficiency. It is likewise unfortunate when reviewers venture outside their competence. Nowhere are these regrettable occurrences more prevalent than in the reviewing of books on statistical theory and methodology. Furthermore, the consequences are serious, for the majority of readers and users of statistical text-books and manuals are not qualified to judge the validity, accuracy or limitations of the material before them. In selecting a book on statistical theory or methodology, it is often necessary at the present time to examine several reviews of the same book. This comparison of evaluative statements appearing in diverse journals and periodicals is greatly facilitated by the book under discussion here.

"The Second Yearbook of Research and Statistical Methodology Books and Reviews," like the first volume of this series,[1] is a collection of book review excerpts. By the editor's count, "'The Second Yearbook' contains one thousand six hundred and fifty-two review excerpts from two hundred and eighty-three journals compared to six hundred and thirty-five review excerpts from one hundred and thirty-one journals in the first volume." Only one journal, *Economica,* did not grant permission to excerpt its reviews; suitable reviews in this journal consequently have been indexed but not excerpted. The journals utilized represent a wide variety of fields: accountancy, actuarial science, agriculture, anthropology, business, biology, economics, education, engineering, entomology, eugenics, forestry, general science, genetics, mathematics, medicine, philosophy, physics, plant pathology, political science, psychology, public health, sociology, statistics, veterinary science, and others. A directory of these periodicals is provided for the first time, and in it are listed the editor's name, the location of the editorial offices, the number of issues per year, the price, the name of the organization of which the journal is the official organ, etc. Other new features are a publishers' directory and the addition of authors' names as catchwords in the running heads at the top of each page. As the books are arranged in alphabetical sequence according to authors, the last-mentioned feature greatly facilitates reference to the books by a particular author. The index of names provided does not distinguish in its references between books and book reviews by the individual concerned and could be made more useful by printing in different kinds of type the numbers which designate books and book reviews by a given individual. An index of titles, a classified index and a publishers' index and directory are provided also.

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[1] "Research and Statistical Methodology Books and Reviews of 1933–1938." Edited by Oscar Krisen Buros. New Brunswick, N. J.: Rutgers University Press. 1938. $1.25.

"The Second Yearbook" lists three hundred and fifty-nine books written in English and published in 1933 or since, the great majority accompanied by at least one review excerpt. About one third of these were listed previously in the first volume and are included again in accordance with the policy to continue listing books in successive yearbooks as long as new reviews appear. In such cases references are given to the reviews appearing in the first volume. The excerpts in "The Second Yearbook" are longer and more informative than those in the first volume of this series. Other improvements are a better format, larger type and a more natural numbering system—the curious system employed in the first volume was bewildering to many users. "The Second Yearbook" is on the whole a marked improvement over the first of the series. The editor seems to have profited from the reviews of the first volume, excerpts from these reviews being included in the present volume.

The objectives of this yearbook series in its present form are listed in the preface as follows:

> (a) To make students and teachers of statistics more keenly aware of the inadequacy of much of what is now presented in text-books and classes despite the fact that such statistical techniques are incorrect, inefficient, and obsolete. (b) To help students, teachers, and librarians to select text-books with greater discrimination. (c) To point out to students and teachers the weak and strong points of particular books. (d) To assist more advanced students in keeping abreast of modern developments in monograph and textbook writing and criticism. (e) To encourage research workers to consider and examine methodology books intended for workers in other fields and also books on general history of science, scientific method, and the social relations of science. (f) To emphasize that there are usually marked differences of opinion even among the more advanced students of statistical theory in their appraisal of a particular book. (g) To indicate the vast extension of fields in which statistical techniques are being found useful and necessary. (h) To discourage the writing and publication of stereotyped textbooks written by persons ignorant of modern developments in statistical theory. (i) To make readily available important and provocative statements which, though appearing in book reviews, have considerable value entirely apart from a consideration of the book under review. (j) To improve the quality of reviews by stimulating editors to take greater pains to choose competent reviewers who have the industry and the courage to contribute frankly critical reviews following a careful study of the book being reviewed. (k) To improve the quality of book reviews by stimulating reviewers "to take their responsibilities more seriously" by refusing to review books which they cannot, or will not, appraise competently and honestly.

In pursuing these objectives the editor of "The Second Yearbook" has been limited by the extent to which the reviewers themselves made these their goals —he could only quote from what was before him. "The quotations represent the critical portions of all reviews which could be located, even though some of these reviews seemed to have been written by persons who either were incompetent to appraise the book under review or were unwilling to speak frankly. [The aim has been] to present in an unbiased manner the evaluative comments contained in all reviews which [could be located]. The amount of space devoted to excerpts for a given book is in direct proportion to the number of evaluative reviews located and not necessarily to the importance of the book." As a result of this editorial policy, "The Second Yearbook" is somewhat encumbered with inconclusive excerpts from inconclusive reviews. While this may be all right from the viewpoints of objectives (j) and (k), it greatly dulls the effectiveness of "The Second Yearbook" as a guide in the selection of books, *i.e.*, from the viewpoints of objectives (a) to (c). The present reviewer feels that the editor would do well in the preparation of future yearbooks to strive for maximum guidance in the selection of books, by including only the most informative and provocative statements, leaving objectives (j) and (k) to be attained indirectly through his presentation of examples of good reviewing.

The excerpting seems to have been done without noticeable bias. From a comparison of numerous excerpts with the original reviews, it can be said that on the whole the excerpts faithfully reflect the opinions of the original reviewers relative to the authors' choices of subject matter and their presentation of it. By making available in one place some really evaluative statements originally appearing in very diverse journals, the editor has rendered a great service to all who try to select the best from the mass of current literature on statistical theory and methods. Incidentally, from a comparison of some of the reviews presented here, the present reviewer wonders whether it might not be desirable in certain instances to have reviews jointly written by an expert on the theory involved and a person experienced in the field of application.

While the excerpts in "The Second Yearbook" provide a good summary of the reviewers' opinions of a given book, they generally fail to give an adequate guide to its contents, even when all excerpts for this same book are viewed collectively. In most instances the original reviews contained a listing of the contents, but these portions were generally omitted in the excerpts. Since such information is most essential for objectives (a) to (c), the present reviewer feels that the editor should devise some scheme for including this information in future yearbooks.

On account of its cost, which really is not excessive considering the work involved, it is unlikely that "The Second Yearbook" will find its way into the libraries of all persons interested in statistical theory and methodology. On the other hand, it should be available in departmental libraries of all departments employing statistical methods in their research, and, on account of its fairly comprehensive listing of books on history of science and scientific method, it should be a useful volume in almost every scientific library. As noted above, only books written in English are included in the present volume, but the editor comments, "If 'The Second Yearbook' is well received, foreign-language books will probably be included in the next yearbook." The continuation and improvement of this yearbook series are thus placed squarely on the shoulders of the scientific public.

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CLINICAL PELLAGRA

Clinical Pellagra. By SEALE HARRIS. 494 pp. 66 figures. St. Louis: C. V. Mosby Company. 1941.

THIS book is the first on pellagra by an American author in more than twenty years—a period during which there has been greater progress in our knowledge of the disease than in all the rest of the history of pellagra. It therefore covers a most important period for the reader who has not closely followed the technical literature.

The author has been closely connected with the pellagra problem in this country from the discovery of the endemic disease here to the present time, although most of his work was done in the earlier period. The book is primarily one for the clinician, and the sections covering the symptoms and treatment are the most valuable. The book is beautifully illustrated, thus enhancing its value to those interested in the deficiency diseases. The number of excellent photographs of the various lesions of pellagra constitute the best published collection.

The chapters written by the author's collaborators lend much weight to the work and present the views of other centers. The chapter on Pellagra in Childhood by Dr. Katharine Dodd deals with a phase of the disease which previously has been greatly neglected. The presentation of the research work of the investigators at the University of Georgia and Duke University adds materially to the completeness of presentation but necessarily results in some repetition.

Much of the first three sections of fourteen chapters is taken up with a consideration of former theories about the etiology of pellagra, which have now been discarded. The chapters on history and epidemiology are interestingly written and he writes very entertainingly on the history of the disease in this country. His easy style and personal experiences add an attractive flavor to this section of the book, which is infrequently found in medical books.

The chapter on pathology is exceptionally short (9 pages) and sketchy in comparison with the other portions of the book.

Dr. Harris includes an unusual section entitled, "Plagues from Devitaminized Foods," which is a philosophical discussion on the wide use of refined foods in this country. He contends that the vitamin fad is not good for the general population and his insistence that proper dietary habits would solve the problem is entirely sound from a theoretical point of view.

The author frankly states that many of the ideas expressed are his own and not always in accord with other observers. He states that alcohol is one of the important factors in the causation of pellagra because of its hepatoxic action and the consequent disturbance of storage or utilization of vitamins. He feels that the last word has not been said in regard to nicotinic acid, and many would disagree with his point of view that pellagra is no longer a major health problem in the South. There is some tendency to generalize on scanty evidence which detracts from the value of the book. Some space is given over to discussing the attitude of the rest of the country to the diseases of the South and how they have been enormously emphasized to the detriment of that section.

The book is especially recommended to nutritionists and clinicians interested in the deficiency diseases because of the excellence of the presentation of the clinical picture of pellagra and the photographs of the lesions. However, the reader must use discrimination in his acceptance of the personal opinions advanced by the author since they are at variance with the present generally accepted views.

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QUOTATIONS

REPORT OF THE PRESIDENT OF HARVARD UNIVERSITY

A specific and challenging program for the adaptation of colleges to training for war needs and a vital discussion of the moral problem now facing men of student age are contained in the annual report of President Conant to the Board of Overseers—a report necessarily devoted largely to war-time problems.

Mr. Conant offers a practical outline for enlarged service on the part of American universities in wartime, and states that the question of whether a student should or should not volunteer is a personal decision in which the duty of the college is to give a *maximum of information* and a *minimum of advice*. Each individual must decide for himself, "for he will have to live with himself and face the consequences of the decision for the remainder of his days."

A Program for Wartime

The requirements of the nation now take precedence over all other considerations, the president declares, and the immediate future of our universities depends upon the settlement of the relation of the university's educational work to the mobilization of young men for the fighting forces. For the satisfactory solution of this problem Mr. Conant proposes a threefold plan:

(1) An authoritative and comprehensive survey of the country's needs for trained men and women, including a survey of the present supply of skilled man power in non-defense industries.

(2) Additional thought to the possibility of more extended use of the colleges and universities for the training of officers.

(3) Consideration by the government of a modified system for selecting candidates for commissioned rank—a system which might include selection of potential officers after graduation from high school and a government-financed education combining both military training and college work.

A Survey of Man Power

During the past year, Mr. Conant recalls, American colleges and universities have been helping to build up a reservoir of trained talent in different areas. Local draft boards have deferred the induction of advanced students of special subjects, but no quantitative estimate of supply and demand has been made. He declares:

> Now that there is just one object before the country, namely, the winning of the war as speedily as possible, such a quantitative appraisal not only becomes feasible from a practical point of view but vitally important. Unfortunately it is not possible to appraise the needs for university graduates in the post-war period. One can estimate the country's requirements for the prosecution of a war in terms of men as well as material. It would be possible, for example, to state how many air pilots or physicists will be needed. But no one can say how many architects or economists will be required in an America returned to peace. Without in any way minimizing the importance of informed leadership in the post-war world or the difficulties of winning the peace, we must recognize that a speedy victory is the prerequisite to any post-war world worth organizing. It is for war, therefore, and not for peace that we must now lay our immediate educational plans.

Officer Training

Concerning the more extended use of the colleges for officer training, Mr. Conant cites the past value of the Army and Navy R.O.T.C. and the present service which these organizations are doing. One unfortunate aspect of the situation, he says, is the "unequal distribution of opportunities for officer training among the various colleges." If there is sufficient need under the expanded program of the armed forces, an increase in the size of the units might be desirable. At present, he says, there are at Harvard many more potential officers among the students than can be cared for by the R.O.T.C.

The president notes that two objections have been made to more extensive officer training in the colleges. The first is the fear of educators that it would result in dilution and militarization of the curriculum and, conversely (on the part of military men), that the training could be done better in independent camps devoted entirely to military subjects. The second objection—that the expansion of the R.O.T.C. would result in recruiting officers from one economic level—is more serious, the president maintains. Despite state- and city-supported institutions and the scholarship plans of the privately endowed colleges, the American college communities are recruited principally from the more prosperous third of the nation. Yet, he argues, even under Selective Service, will not the corps of officers be built from one economic group tending to place college men in the vast majority?

If the country, then, really wishes to develop all possi-

> bilities for recruiting its officers for the Army on a democratic basis, should it not direct its attention to the possibility of a new policy based on the selection of promising *boys at the time of graduation from high school?* . . . The potential officers should be selected on their qualifications for leadership and irrespective of the financial status of their parents. They could be inducted into some form of military organization as privates, and be sent at government expense to our colleges to be trained as officers in R.O.T.C. units. A general program in the first year of college would serve as the basis of a further selection; an intensified program in the following years of college could then be as short or as long as the Army might decide. Preferably, these men should not be under complete military supervision during their collegiate work, but rather on a special furlough arranged with sufficient pay to cover their expenses.

Almost all the youth of the country attend high school, but under normal circumstances less than one in ten goes to college, Mr. Conant says. From the point of view of democratic society and the future of the Army and Navy, this selective system of picking officers "would seem to justify the expenditure of funds required." For a long war it would guarantee a supply of the best officer material in each age group with some background of education beyond the secondary school level, and without regard to the accidents of parental fortune. The president adds:

> This last result would not constitute the least of the merits of such a plan. For if under the terrific pressure of a major military effort, we can preserve and extend the American tradition of equal opportunity—opportunity for all—we shall have taken a long stride toward demonstrating that we can fight this war without sacrifice of those ideals for which the issue has been joined.

THE UNDERGRADUATE'S PROBLEM

Reviewing the plans for a general speed-up of the university curriculum on a twelve-month basis (*Bulletin,* January 10), President Conant summarizes the relations between the average college undergraduate and the armed forces in war time. The university has accelerated its program to enable men in college to finish their academic work before joining the armed forces and at the same time has not relaxed the fundamental requirements for a degree.

With the lower limit of call under Selective Service set at twenty years of age, it is important, Mr. Conant emphasizes, that a way be open for younger men to join certain branches of the Army of their own free will. He cites Secretary Stimson's statement that men under twenty are needed because the combat services "must contain individuals possessing keenness, enthusiasm, daring, vigor and endurance." Says Mr. Conant:

> In this, as in preceding wars, it seems that able-bodied young men as yet untrained as specialists must largely determine their own futures. The decision is a difficult and trying one for a young man to make. But each *individual must make it for himself, for he will have to* live with himself and face the consequences of the decision for the remainder of his days. The question of whether or not he can be of greater service by volunteering for active duty or by taking another path can only be settled by each person for himself—settled on the basis of the best evidence he can command and in the light of his own convictions.
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> Selective Service is, in general, a rational and fair way of building an army. We must recognize, however, that it has certain limitations and that these limitations place a heavy burden on our younger college students. . . . The duty of the college to all its students, as I see it, is to give them the maximum of information and the minimum of advice. *Certainly no one would wish to lower the* morale of a nation embarked on a critical struggle by dampening the fighting spirit of those who are eager to join the colors. The national government may at some later time prohibit students with certain talents from enlisting. In the meantime college faculties and administrative officers can hardly undertake to shoulder the responsibility of directing the future of those who wish to join the fighting forces.

FACULTY AND DEFENSE

Evidence of the "spirit that prevails" can be found in the unanimous vote of the faculty to place themselves at the disposal of the university for a twelve-month year without additional compensation, President Conant continues.

Already many men of the faculty have been engaged for a year and a half in an "ever-increasing load of defense work." These activities have included those professors who have devoted a portion of their time to government work in Washington or are on leave of absence for this purpose; staff members on leave of absence with the armed forces; research workers under government contract; and those taking part in educational programs connected with the defense effort.

In his article in the last *Bulletin* (January 10, 1942) Dean George H. Chase, '96, mentioned the serious loss of faculty personnel which the university is facing and cited figures showing how many Harvard teachers are giving full- or part-time to the cause of victory. Since last week these figures have been revised enough to be certain that more than 100 members of the faculty have now been granted leaves of absence for defense work (74 received leave in September, 1940, and 63 in September, 1941, although some of these leaves overlap). At least 142 members of the faculty are known to be engaged in part-time war work, and Mr. Chase declared that 286 are now engaged in defense work of some sort in addition to their teaching loads. This number is swelling daily. The *Bulletin* hopes to print more definite information on the subject in the near future, when the university will have more complete records.

The whole story can obviously not be told because so much of the work is of a secret character. But, as Mr. Conant says in his annual report, "if the whole story could be told, it would demonstrate a record of national service among members of the university staff which would be a deep source of pride to all Harvard men." He writes:

> The first asset of a modern university is neither its invested capital nor its plant. The first asset is the faculty. In all our attempts to conserve dollars during the war emergency, therefore, we must be certain that we do not impair the quality of our staff. . . .
>
> During the war years and particularly when hostilities cease, we must bend every effort to strengthen each of our dozen faculties by the addition of the ablest teachers and the most distinguished scholars available. If we succeed in this endeavor we shall insure a brilliant future for this university, whatever fluctuations in our financial fortunes may occur. If we fail, it will be of little moment to the nation whether the figure representing Harvard's dollar assets has moved up or down.—*Harvard Alumni Bulletin.*

SPECIAL ARTICLES

A FACTOR IN DOMESTIC RABBIT PAPILLOMA TISSUE HYDROLYZING THE PAPILLOMA VIRUS PROTEIN[1]

THE virus of infectious papillomatosis[2] is seldom demonstrable[3] in domestic rabbit growths. On the other hand, growths occurring under natural conditions in cottontail rabbits usually yield highly infectious extracts.[2] Further, the virus can be obtained as a homogeneous protein from growths in cottontail rabbits but not from growths in domestic rabbits.[4] The chief reason for suspecting virus in most domestic rabbit warts is the presence of a specific antigen which immunizes[5] other rabbits against infection with the virus. Even in this respect, there is evidence that virus as such is not present in suspensions of the growths, for the antigen is retained by Berkefeld filters, through which the virus readily passes, and is sedimented in ultracentrifugal fields which do not affect the virus. An explanation for the absence of virus and an insight into the probable nature of the antigen of domestic rabbit warts is suggested in the results of the experiments described here.

There is evidence that the papilloma virus is a macromolecular nucleoprotein.[6,7,8] The protein, introduced into susceptible hosts, gains entrance into epidermal cells and there progressively increases in quantity in cottontail and, presumably, also in domestic rabbits. It is conceivable that in these cells there exist not only factors which participate in the synthesis of the virus protein but others which may degrade it. In domestic rabbits the activity of the degrading factors may keep pace with that of factors influencing synthesis. The present work demonstrates a factor, presumably an enzyme, in domestic rabbit wart tissue which hydrolyzes the papilloma virus protein.

TABLE 1

THE EFFECT OF DOMESTIC RABBIT PAPILLOMA TISSUE ON THE PAPILLOMA VIRUS PROTEIN AS MEASURED BY FORMOL TITRATION. THE AMINO NITROGEN WAS DETERMINED BY THE VAN SLYKE METHOD ON THE TRICHLORACETIC ACID FILTRATE

	Time (hours)	cc 0.01 N NaOH Papilloma tissue + virus protein	cc 0.01 N NaOH Papilloma tissue	cc 0.01 N NaOH Virus protein
	0	2.0	2.0	0.43
	3.3	2.4	1.8	0.43
	21.5	3.6	2.4	0.43
	30.5	4.5	3.2	0.78
Total virus protein N	0	0.3 mg		0.3
Amino N found (Van Slyke)	30.5	0.16 mg*		0
Amino N equivalent (from formol titration)		0.13 mg		
Percentage of total N as Amino N (Van Slyke)		53		0

* In excess of the amount present in the filtrate of papilloma tissue alone.

Table 1 shows a typical experiment with papilloma tissue from the domestic rabbit. The rabbit was inoculated broadcast with the virus protein in scarified areas on the abdomen and sides. The resulting confluent growths were sliced off when 1–2 mm high, washed free of blood in 0.9 per cent. sodium chloride solution, and ground with sand in 0.05 M phosphate buffer pH 6.5. The tissue suspension was decanted, diluted and 1.0 cc was added to each of 2 tubes. To one tube 1.0 cc of solution containing 2.0 mg of virus protein was added and to the second 1.0 cc of water. In a third tube 1.0 cc of buffer was added to 1.0 cc of virus protein solution. 0.2 cc of 0.1 M NaCN and 0.1 cc of toluene were added to all tubes which were then incubated at 37° C. Immediately and at intervals samples were withdrawn for formol titration. At the end of the experiment an equal volume of 20 per cent. trichloracetic acid was added to the remaining solutions, and the amino nitrogen was determined on the filtrates by the Van Slyke method.

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[1] This work was aided by the Dorothy Beard Research Fund and by a grant from Lederle Laboratories, Inc., Pearl River, N. Y.

[2] R. E. Shope, *Jour. Exp. Med.*, 58: 607, 1933.

[3] R. E. Shope, *Proc. Soc. Exp. Biol. and Med.*, 32: 830, 1935.

[4] J. W. Beard, W. R. Bryan and R. W. G. Wyckoff, *Jour. Infect. Dis.*, 65: 43, 1939.

[5] R. E. Shope, *Jour. Exp. Med.*, 65: 219, 1937.

[6] D. G. Sharp, A. R. Taylor, D. Beard and J. W. Beard, *Jour. Biol. Chem.*, 142: 193, 1942.

[7] H. Neurath, G. R. Cooper, D. G. Sharp, A. R. Taylor, D. Beard and J. W. Beard, *Jour. Biol. Chem*, 140: 293, 1941.

[8] A. R. Taylor, D. Beard, D. G. Sharp and J. W. Beard, *Jour. Infect. Dis.* Submitted for publication.

Table 1 shows that the papilloma tissue itself undergoes autolysis, but in the presence of the virus protein more carboxyl groups are liberated. Since the virus alone remains stable, this increase in carboxyl groups may be attributed to the hydrolysis of the virus by the papilloma tissue. The results of the amino nitrogen determination on the trichloracetic acid filtrate confirm this; 53 per cent. of the total virus protein nitrogen was liberated as free amino groups. Under exactly similar conditions the virus was not hydrolyzed by papilloma tissue from cottontail rabbits, although the tissue alone showed some autolysis. The virus was also not hydrolyzed when it was incubated with normal domestic rabbit epidermal cells[9] treated in the same way.

It appears that the papilloma virus protein is hydrolyzed by some factor, presumably an enzyme, in domestic rabbit papilloma tissue which was absent in the cottontail rabbit wart tissue thus far studied. In the experiment shown in Table 1 the weight of papilloma tissue was not more than 0.2 gm, and the quantity of virus changed was 1.05 mg. Other experiments gave similar results, and the rate of hydrolysis was not increased by doubling the virus protein concentration. Crystalline horse serum albumen and the macromolecular component of normal chick embryo[10] were not hydrolyzed by the domestic rabbit papilloma tissue. The indication is that the catalyst is specific for the virus protein or similar compounds.

The results demonstrate a mechanism by which the papilloma virus may be degraded as fast as it is formed in domestic rabbit papilloma tissue. It is possible, though no evidence of it was seen here, that such a mechanism may operate in lesser and varying degree also in cottontail rabbits to account for variations in the virus content, especially in experimentally induced growths.[4] The findings are not incompatible with the antigenicity of domestic rabbit wart material, for the antigen could well be a non-infectious, insoluble and possibly partially denatured degradation product of the virus, somewhat analogous to the degraded virus antigen of equine encephalomyelitis vaccines.[11] The possibility exists that a similar mechanism accounts for the absence of virus from the carcinoma based on the papilloma of domestic rabbits,[12] as well as that which derives from papillomas of cottontail rabbits.[13] The cells of the latter may acquire virus-degrading factors or enzymes in the carcinomatous change. It is an obvious possibility that such factors may prevent the recovery of a causative agent from neoplastic growths other than those associated with the papilloma virus.

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THE RESPIRATION OF ELODEA

MEASUREMENTS of respiration on higher aquatic plants are seldom performed. The present investigation, originally to determine the relation of cation intake to gaseous metabolism, provided a better insight into the metabolic implications of a hydrophytic existence. Slight modifications of the Fenn-Ledebur[1] microrespirometer allowed simultaneous measurement of carbon dioxide production and oxygen consumption of excised leaves of *Elodea canadensis* Michx. with facility. A barium hydroxide solution was used to absorb the carbon dioxide, and its conductance was measured at intervals by the use of the Kohlrausch bridge method. Experiments averaged three hours in length and were performed in the dark.

Respiratory quotients were very high (average 8.4), suggesting the possible occurrence of anaerobiosis, possibly in connection with or in addition to the utilization of chemically bound oxygen. Presence of previously stored substrates rich in chemically bound oxygen would decrease the amount of free oxygen necessary for complete combustion, would lower the apparent oxygen consumption, and thus cause the R.Q. to rise. Substances like oxalates and citrates would serve well as such substrates; in fact, calcium oxalate has been identified in cell vacuoles of elodea leaves.[2] Migration of oxalic, citric or other acids to the surface of the tissue would liberate carbon dioxide from the carbonate-incrusted leaves, also apparently increasing the R.Q. According to Gregory and Sen,[3] the rate of liberation of carbon dioxide may indicate the rate at which the protein cycle, involving deamination and protein synthesis, is taking place.

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[9] For this, layers of cells were thinly shaved from the ears and abdominal skin. The results are of dubious significance for the amount of cells thus obtainable is minute.

[10] A. R. Taylor, D. G. Sharp, D. Beard and J. W. Beard, SCIENCE, 94: 613, 1941.

[11] D. G. Sharp, A. R. Taylor, H. Finkelstein, D. Beard and J. W. Beard, *Proc. Soc. Exp. Biol. and Med.*, 43: 650, 1940.

[12] P. Rous and J. W. Beard, *Jour. Exp. Med.*, 62: 523, 1935.

[13] J. G. Kidd and P. Rous, *Jour. Exp. Med.*, 71: 469, 1940.

[1] Wallace O. Fenn, *Am. Jour. Physiol.*, 84: 110, 1928. J. Frhr. v. Ledebur, *Mikrochemie*, Pregl-Festschrift (Sonderband), 253, 1929.

[2] Daniel Mazia and Jean M. Clark, *Biol. Bull.*, 71: 306, 1936.

Chemical storage of oxygen is obviously of advantage to the plant, since it is not only subjected to widely varying degrees of oxygen tension in its aquatic environment, but photosynthetic activity in the winter months is apt to be curtailed. In this connection it was interesting to note the change in gaseous metabolism as the rainy season (1940–41) drew to a close. From January to mid-March the oxygen consumption rose about threefold, the carbon dioxide production neither rising nor falling conspicuously. This change was presumably conditioned by an increase in illumination, causing an increase in photosynthetic activity, in turn causing storage and subsequent breakdown of carbohydrates, and in this manner involving a shift to aerobic oxidation. It is conceivable that the oxygen consumption may also have been affected by the cessation of dilution of the pond water by rain and commencement of concentration of ions by evaporation loss. Further pursuit of these questions should throw more light on the physiology and ecology of such forms.

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ON THE SIZE AND SHAPE OF THE TOBACCO MOSAIC VIRUS PROTEIN PARTICLE

The proposition that the tobacco mosaic virus protein is molecularly dispersed in aqueous solution has been staunchly defended by Stanley and his coworkers. In response to a paper by Bawden and Pirie,[1] who originally demonstrated that this virus protein has a marked tendency to aggregate, Loring, Lauffer and Stanley[2] announced that the virus protein "has a molecular weight of at least 46 million, a length of at least 430 millimicrons, and an effective diameter of about 12 millimicrons," and that aggregation, if any does occur in the virus protein solutions, is of little significance. Essentially this same point of view has been maintained consistently by Stanley and his coworkers, although in more recent papers, in particular those relating to the research with the electron microscope,[3,4] they speak of a "marked tendency of the particles to aggregate." These workers have avoided consideration of the various anomalies shown by solutions of this virus protein and they consider the size and shape of the protein particles arrived at from ultracentrifuge and viscosity studies as valid and accurate. The electron microscope photographs are cited as substantiating evidence, and the conclusion is reached from a consideration of these photographs that the length of the protein molecule is 280 millimicrons. This conclusion is reached notwithstanding the fact that there are many particles shown in the electron microscope photographs that are considerably shorter than 280 millimicrons.

One might be expected to suppose that all molecules of a given species would be of the same size. In the case of a protein preparation having a heterogeneous size distribution one would suspect either that the preparation is impure or that association or aggregation has occurred, in which case the size of the various particles would be simple multiples of some basic unit. Fortunately in the case of the electron microscope photographs of this virus protein, the sizes of the various particles may be measured, albeit the accuracy is not of a high order. It is impossible, for example, to be sure that all the particles are lying flat, and measurements made from a half-tone reproduction are not particularly satisfactory. Although the errors in the estimations of the lengths of the virus protein particles from these and similar photographs are large, a length distribution curve for 159 particles occurring in the photographs published by Stanley and Anderson[3] and Anderson and Stanley[4] is presented in Fig. 1.

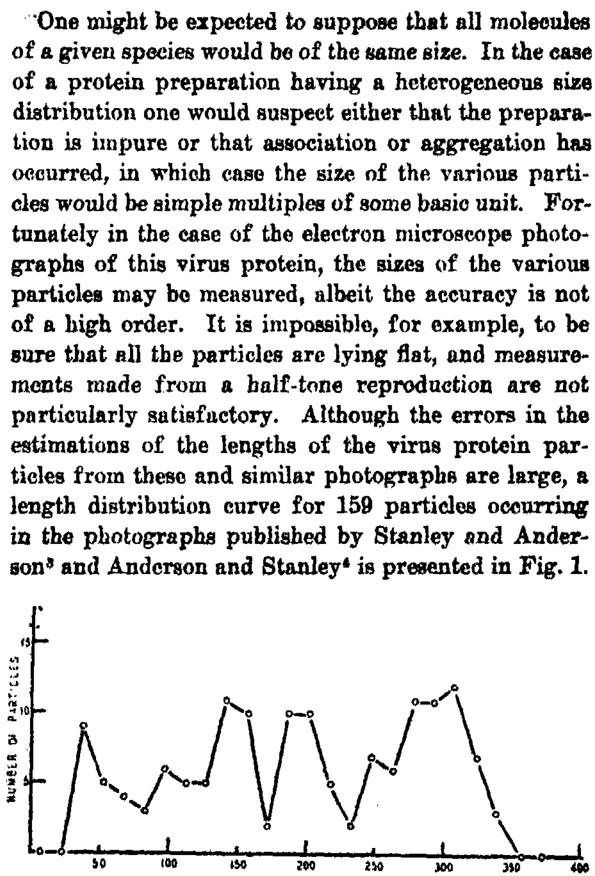

Fig. 1. Length distribution curve for particles of tobacco mosaic virus protein. Data taken from electron microscope photographs.

The class length along the abscissa is 15 millimicrons. Note that a bunching occurs at lengths in the regions of 300, 190, 150, 100 and 37 millimicrons. These lengths are essentially in the ratio of 8 : 5 : 4 : 3 : 1.

The implications of the orderliness indicated above are obvious.

An added item of interest is the observation by Melcher, Schramm, Trurnit and Friedrich-Freksa[5] that the electron microscope photographs of their preparations showed particles whose lengths were predominantly in the neighborhood of 140 and 190 millimicrons. In keeping with their decision that the length of the virus protein molecule is 280 millimicrons, Stanley and Anderson[3] concluded that Melcher and coworkers must have been dealing with some different strains of the virus. These same particle lengths occur in the electron microscope photographs published by Stanley and Anderson[3] and by Anderson and Stanley.[4]

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[3] F. G. Gregory and P. K. Sen, *Ann. Bot.*, n.s. 1: 521, 1937.

[1] *Proc. Roy. Soc.*, B 123: 274, 1937.

[2] *Nature*, 142: 841, 1938.

[3] *Jour. Biol. Chem.*, 139: 325, 1941.

[4] *Jour. Biol. Chem.*, 139: 339, 1941.

[5] *Biol. Zentr.*, 60: 524, 1940.

A further consideration of equal interest is that the size of the suggested basic unit from which the other particles seem to be built is in good agreement with the "diameter" of some 38 millimicrons arrived at by Thornberry[6] from ultrafiltration experiments. One might wonder just what the electron microscope photographs of these ultrafiltrates would show.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

CHROMATOGRAPHIC SEPARATION OF MIXTURES OF AMINO ACIDS

THE recent report by Tiselius[1] of the adsorption analysis of certain mixtures of amino acids by a modification of the Tswett chromatographic method has led us to publish at this time results of our own work.

We have been able to separate mixtures of *l*-tyrosine and *dl*-leucine, and of *dl*-phenylalanine and *dl*-leucine, in a quantitative, or nearly quantitative manner. Other separations, such as that of *l*-tyrosine from *dl*-phenylalanine or of glycine from *dl*-alanine, have been obtained but are not yet quantitative. A representative experiment is given below. We hope shortly to publish our findings in full.

Materials. A variety of *adsorbents* have been investigated. The experiment described below employed a commercial carbon, Darco G–60.[2] *l*-Tyrosine, partially racemized, analyzed 7.69 and 7.75 per cent. nitrogen and gave no nitroprusside test for cystine. *dl*-Leucine analyzed 10.71 and 10.74 per cent. nitrogen.

Experiment. Two grams of Darco G–60 carbon were mixed with filter paper pulp (a convenient, non-adsorbing bulking agent) and packed in a tube 2.2 cm in diameter to give a column of adsorbent 12 cm long. To this was applied a solution containing 0.5006 g *dl*-leucine and 0.1008 g *l*-tyrosine in 100 cc of water. The column was developed with water in the usual manner and without pressure. The liquid which passed through the column was collected in fractions and analyzed for amino acid. All the leucine was obtained in the first 600 cc of liquid which passed through the column (0.5016 g in 15 fractions), and in no fraction was there any evidence of tyrosine (Folin-Marenzi test). At this point all the tyrosine remained on the column and the percolating liquid gave a negative ninhydrin test and a negative Folin-Marenzi test.

The strongly adsorbed tyrosine could be desorbed by elution with aqueous ethyl acetate: 550 cc of 5 per cent. aqueous ethyl acetate removed about 90 per cent. of the tyrosine (by colorimetric estimation, checked gravimetrically).

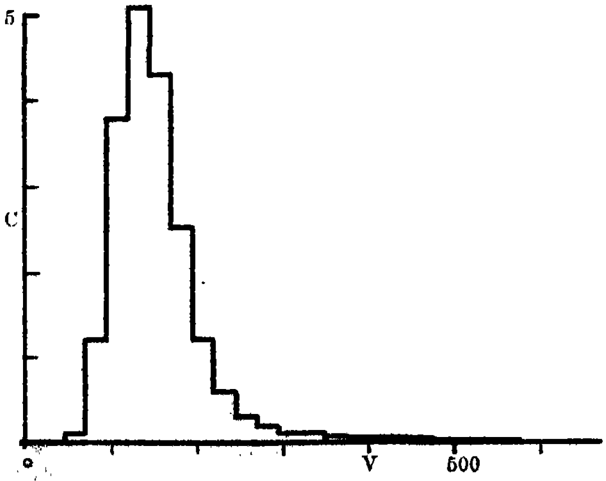

FIG. 1

"Zone" of *dl*-leucine.
V Volume of percolate, in cc.
C Concentration of fractions shown, in mg. per cc.

The concentrations of leucine in the fractions of percolate are plotted (Fig. 1) against the volume of percolate to show how the "zone" passed completely from the column. This method of plotting is useful in dealing with the separation of colorless materials.[3]

This problem is being developed further in this laboratory.

At this time we would like to express our thanks to Dr. Hubert B. Vickery and Dr. Werner Bergmann for many kindnesses, and to the International Silk Guild for funds in support of this work.

JACQUES WACHTEL
HAROLD G. CASSIDY
YALE UNIVERSITY

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[1] A. Tiselius, SCIENCE, 94: 145, 1941.

[2] The Darco Corporation, 60 East 42nd Street, New York, N. Y.

[6] *Phytopathology*, 25: 601, 1935.

[3] H. G. Cassidy, Dissertation, Yale University, 1939; E. Caliri, Thèse, University of Fribourg, 1939; H. G. Cassidy, *Jour. Am. Chem. Soc.*, in press.

CEREAL CELLULOSE, A ROUGHAGE MATERIAL SUITABLE FOR EXPERIMENTAL ANIMAL DIETS

MANY animal diets are deficient in material that supplies bulk or roughage and carries moisture through the intestines. It has become a rather common practice of nutritionists to add agar to basal diets for its laxative value. Because of its indigestibility and its gel-forming properties it is effective in furnishing bulk and carrying moisture. Lately, however, it has been observed that agar is not nutritionally inert, particularly in that it carries significant amounts of biotin and possibly other factors. The main supply of agar comes from Japan and hence a serious shortage is imminent. Because agar is important for bacteriological work in hospitals and food manufacture and for research it is desirable to conserve it for these most essential uses.

The use of cellulose for dietary roughage is of course well known, as it is a normal constituent of herbivorous and omnivorous animal diets. For experimental diets it must be available in a substantially pure state and in a desirable physical form. For a number of years a cereal cellulose of high purity from the nutritional standpoint has been used to supply roughage in a commercial breakfast cereal, namely, a flaked rice. This cereal cellulose has been in use for many years in the animal diets used for nutritional studies at Mellon Institute and at the University of Pittsburgh. It has also been utilized similarly in the research laboratories of several medical schools. The material, where used to the extent of about 5 per cent. in the diet, has been found very effective in preventing constipation. There has been no evidence of its furnishing any nutritional factors.

This special cellulose is derived from rice hulls by a series of chemical processes that remove practically all the non-cellulosic ingredients except a little coloring matter and less than 1 per cent. of a siliceous ash. It is in the form of a very light brown fluffy meal of a particle size that will pass a standard 40-mesh screen. The following are some of the analytical data for the product:

	Percentage
Nitrogen	0.043
Ash	0.71
Calcium	0.022
Phosphorus	nil
Iron	0.001
Aluminum	0.016
Silica	0.42

The product contains no protein or fat. It is so low in calcium and phosphorus that it is quite suitable for all ordinary studies on these elements. As the material is dried in a steel rotary dryer the small amount of iron contained may make it unsuitable for use in diets designed to study iron availability. A thiochrome test for thiamine gave a negative result. It has been used for years in basal diets for thiamine and riboflavin assays with the negative control diets showing growth responses indicating complete absence of these vitamins. The high-pressure chemical process of treatment together with the extensive washing of the material assures destruction or removal of all vitamins.

The cellulosic ingredients of the product include about 70 per cent. of alpha-cellulose with the rest made up of simpler celluloses and hydro-celluloses. The digestibility of the material for different animal species has not been determined, but it is believed it is largely indigestible, particularly in the white rat, in the diet of which it has proved an effective roughage material.

The cereal cellulose has been supplied gratis by the manufacturer to a few research laboratories that have requested it. Plans are under way, however, for one of the larger scientific supply houses to furnish it to all interested research organizations.

E. R. HARDING

MELLON INSTITUTE

BOOKS RECEIVED

CHAPPLE, ELIOT DISMORE and CARLETON STEVENS COON. *Principles of Anthropology.* Pp. xiii + 718. Holt. $3.75.

Contributions toward a Flora of Nevada. Division of Plant Exploration and Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, in Collaboration with the University of Nevada. Numbers 1–21, 23–33.

DAVIES, A. C. *The Science and Practice of Welding.* Illustrated. Pp. viii + 436. Cambridge University Press. $2.25.

The Diseases of the Basal Ganglia. Research Publications, Volume XXI, Association for Research in Nervous and Mental Disease, TRACY J. PUTNAM, editor. 268 Illustrations, 15 Tables. Pp. xii + 719. Williams and Wilkins. $10.00.

HALL, NORRIS F. and OTHERS. *Acids and Bases.* Pp. vii + 103.

MÜLLER, OTTO H. *The Polarographic Method of Analysis.* Pp. vi + 114. Numbers 1 and 2 in *Contributions to Chemical Education.* Journal of Chemical Education. $1.00 each.

LEWIS, WARREN K., LOMBARD SQUIRES and GEOFFREY BROUGHTON. *Industrial Chemistry of Colloidal and Amorphous Materials.* Pp. xi + 540. Macmillan. $5.50.

NEGLEY, GLENN. *The Organization of Knowledge.* Pp. xvi + 373. Prentice-Hall. $4.00.

The Psychology of Learning. Part II—The Forty-First Yearbook of the National Society for the Study of Education, edited by NELSON B. HENRY. Pp. xiv + 502. Public School Publishing Company.

RUSSELL, GEORGE E. *Hydraulics.* Fifth Edition. Pp. viii + 468. Holt. $4.75.

SHERMAN, HENRY C. and CONSTANCE S. PEARSON. *Modern Bread from the Viewpoint of Nutrition.* Pp. vi + 118. Macmillan. $1.75.

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THE MOBILIZATION OF SCIENCE IN NATIONAL DEFENSE[1]

By Dr. FRANK B. JEWETT

CHAIRMAN OF THE BOARD, BELL TELEPHONE LABORATORIES

THERE is perhaps no audience before which the role of science and engineering in modern warfare can more appropriately be discussed than one composed of members of the Institute of Radio Engineers. You are primarily communication engineers and of all the branches of applied science, that which has to do with the rapid transmission of intelligence is perhaps most vital to the successful use of the modern fighting instrumentalities. Rapid movement of troops and supplies over far-flung lines of action on sea and land and in the air are possible only on the basis of very effective systems of radio communication. In fact, more and more are means of communication assuming the function of a unifying influence which pervades the other arms of the military organization. They coordinate the movement of naval and aerial fleets. They enable infantry, tank columns and formations of planes to operate as a single effective unit. They shrink, as nothing else can, a 2,000-mile battle-line to the compass of a single sector.

The telephone and telegraph and particularly the radio telephone and telegraph are, in effect, the keystone of the whole military arch. You members of the Institute of Radio Engineers are, therefore, exponents of a very vital department of technology, and I am particularly grateful to you for affording me the opportunity to speak here at this time to discuss the mobilization of science in the war program.

---

[1] Winter convention, Institute of Radio Engineers, Hotel Commodore, New York, N. Y., January 12.

Further, it is not merely in the fields we ordinarily think of as communication that men who have devoted their lives to the problems of radio development are in position to render great service.

One of the striking things connected with the development of new military tools, both offensive and defensive, is the astounding extent to which the fundamental phenomena on which electrical communication is based are employed. In some cases it is application of established techniques in entirely new fields. More frequently it is the pushing of our frontiers of knowledge farther out, and then applying that knowledge to the problems of war in three-dimensional space. Basically, every military problem hinges on the rapid and exact location of an enemy objective and in transmitting and utilizing the knowledge acquired. This may be for the guidance of a commanding officer; the accurate pointing, fuse setting and firing of a gun; the release of an aerial bomb, or any one of a hundred similar things. Every single physical phenomenon which can be employed must be examined. Because modern science has changed the conditions of warfare from a slow-moving affair in localized areas to one of great rapidity over incredible distances of land, sea and air, it is imperative that those phenomena which have given us radio be developed and utilized to the full.

While the initial problem is one of intense research and development, each step forward involves great numbers of skilled technicians in design, manufacture, maintenance and operation of new implements. It seems clear that the demand for men trained in our art is bound to be enormous, not alone in the laboratory but in the services of supply and in the combat forces as well.

For fifteen years following the first World War there were frequent articles on the probable role of science in future warfare. While this was quite natural in view of the part played by the airplane, the tank and lethal gas in the titanic struggle of 1914–18, the articles in the main evoked interest rather than concerted action directed toward full employment of science in preparation for more wide-spread and more deadly warfare.

Despite the fact that the decade and a half following the war was a period of the most productive activity in fundamental science research and of intense effort to apply old and new knowledge promptly in industry, this *laissez-faire* attitude in the military sector was largely a reflection of men's attitude generally toward war. The weariness of the struggle and the distaste for carnage and destruction, coupled with a naive faith that men had learned finally the lesson of war's futility, gave rise to the era of small appropriations to the military, to disarmament conferences and to the League of Nations and similar efforts to organize the world for a settlement of international controversies by reasonable methods rather than by recourse to mass murder.

In the United States particularly, the decade of the 1920's saw this carried to the extreme. Warships were taken to sea and sunk or were laid up and the Army was reduced to the status of a moderate sized police force—a force so small and scattered that no really effective training or development of radically new implements could be had. Appropriations were cut to the irreducible minimum of maintaining a national agency which the country would have liked to abolish entirely had it quite dared. In this atmosphere and under these handicaps it is to the credit of the Army and Navy that they did as well as they did. There was little money to spend on development and less still for research to produce entirely new instruments of war.

When the storm clouds of another world war began to form in the middle 1930's, the volume of articles on the place and importance of modern science in warfare increased enormously in both the scientific and lay press. So, too, did discussion of the need for insuring that scientific and technical men should be utilized in the fields of their competence and not inducted indiscriminately into the combat services where men of less specialized training could serve equally well.

So far as lay discussion was concerned, it was largely emotional, frequently ill-informed and sometimes fantastic. Naturally, discussion among technical people was more realistic, but on the whole was mainly related to applying newly acquired knowledge and techniques to the improvement of existing military implements. The idea of organizing scientific research on a huge industrial scale, where the ultimate end of "all out war" was the industry to be served, was slow to emerge.

Probably the most difficult hurdle every industry has had to get over in the effective introduction of scientific research as a powerful tool in its operation, has been to realize that the most profitable research is that which is carried on with the least restraint imposed by current practice. Practice can be adapted to radically new ideas, but radical ideas rarely, if ever, evolve from mere improvements in current practice.

Research in military matters is no exception. War being a very ancient art, military men are on the whole extremely conservative as to new tools. Like doctors, long experience has made them cautious and with possibly a more than ordinary tendency to impose on a research project requirements of current practice which, in fact, hamper rather than help. Against this tendency is the fact that they are quick to adopt the radically new once its utility is demonstrated. War more than any other of man's activities puts a high premium on being in the lead.

As soon as war in Europe on a vast scale was seen to be imminent, the nations there commenced frantically to mobilize and organize their scientific and technical men and resources, and to establish effective liaison between them and the combat services. For more than a year after this movement was in full swing across the Atlantic, our aloofness from the struggle and our ardent desire to keep from being sucked into the tragic maelstrom operated to prevent any effective steps in the direction of mobilizing our vast scientific resources for total war. The military services endeavored to strengthen their scientific branches and here and there enlisted the aid of civilian science. They were hampered by inadequate funds, by the pattern of years of a starved organization imposed by an anti-war philosophy, and by the fact that civilian sciences, both fundamental and applied, were built up on a basis of operation in a slow-moving peace economy. The latter had no machinery for marshalling its forces for war and, in the main, it knew little of war's requirements and frequently preferred to follow the courses it understood and liked.

But about two years ago, it became apparent to a few individuals that the *laissez-faire* approach to the mobilization of science ought to be abandoned in favor of a more direct and forceful organizational approach. At that time there existed certain technical groups and associations which, on the one hand, called for strengthening, and on the other were of suggestive value in the search for a suitable organizational set-up. I have already remarked upon the scattered technical groups and laboratories within the Army and Navy which over the years had been doing commendable work, but had been given insufficient funds and encouragement. It was, of course, obvious that as the tension of the emergency increased, the responsibilities placed upon these technical groups would mount with a resultant need to augment their personnel, but it was equally apparent that they could not be expected to carry the full load of scientific development and adaptation.

Civilian participation in one way or another in the solution of military problems has come to be taken for granted. It was first given official recognition in the United States when the National Academy of Sciences was incorporated in 1863 by an Act of Congress. The charter of the academy requires that whenever called upon by any department of the Government, it shall investigate, examine, experiment and report upon any subject of science or art, the actual expenses of such investigations, experiments and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government. The academy is, therefore, recognized as a continuing official adviser to the Federal Government and it must attempt to answer such questions of a scientific or technical nature as are officially submitted to it by members of government departments. A permanent channel of communication was thus created, but power to initiate traffic over it resides with the Government and no auxiliary machinery was created whereby the academy or any other civilian agency might take the initiative in bringing before the Government matters of scientific importance.

Less than a year prior to the entry of the United States into the first World War, a significant step was taken designed to facilitate the use of the channel of communication between Government and the National Academy. In 1916 the National Research Council was created by President Wilson, and a little later was to play a part in focussing civilian effort on the military problems then arising. The National Research Council was, and is to-day, a subsidiary of the National Academy of Sciences and, like the academy, is largely an advisory body only and awaits the assignment of problems by one or another branch of the Government before it can go seriously to work. Moreover, the council, like the academy, is not in possession of free money, a corporate laboratory and other research facilities and is, therefore, not well constituted to conduct research work on any extensive scale.

We turn our attention, therefore, to another agency contemporaneous with the National Research Council, which was created for the express purpose of establishing cooperative effort between military and civilian groups, and which was provided by Congress with funds necessary to create research facilities and to operate them when once created. This agency is the National Advisory Committee for Aeronautics, commonly known as the NACA. The law which created the committee provides that it shall "supervise and direct scientific study of the problems of flight, with a view to their practical solution," and also "direct and conduct research and experiment in aeronautics." The committee is composed of fifteen members, including two representatives each of the War and Navy Departments. Throughout its more than twenty-five years of existence, the NACA has given ample testimony of the fruitfulness of cooperation between military and civilian groups, and moreover has provided a prototype as to an organizational arrangement for effecting such cooperative effort successfully.

When, some two years ago, the group to whom I have already referred became convinced that broader participation by civilian scientists in the whole military program was likely to be essential, they regarded the NACA as typifying the sort of organization they would like to see created. A plan was therefore drawn up envisaging a committee composed in part of civilian scientists and in part of Army and Navy representatives. On the one hand, the committee was charged with a broad study of the materials of warfare and, on the other, it would recommend and, if possible, initiate such research as they believed to be in the national interest.

The NACA was created in 1915 by an Act of Congress. The somewhat duplicative plan just referred to was submitted to President Roosevelt about a year and a half ago for such action as he saw fit to take. The proposal appealed to him and he decided to create the committee by Executive Order. This order established the committee as a division under the Office for Emergency Management and confers upon them power to take the initiative in many scientific matters which they believed to have military significance. It also directed the committee to develop broad and coordinated plans for the conduct of scientific research in the defense program, in collaboration with the War and Navy Departments; to review existing scientific research programs formulated by these departments, as well as other agencies of the Government; and advise them with respect to the relationship of their proposed activities to the total research program. Moreover, and this is especially important, the order directs them to initiate and support scientific research on the mechanisms and devices of warfare with the object of improving present ones, and creating new ones.

The order contemplated that the committee would not operate in the field already assigned to NACA nor in the advisory field of the National Academy of Sciences and National Research Council. Parenthetically, it might be noted that in this latter field the academy and council are currently engaged on advisory work for Government for which the out-of-pocket expenses alone are at the rate of much more than $1,000,000 a year. A recent count shows that the present personnel of Academy and Research Council advisory committees runs to about 225. These figures will give an idea of the vital part which these fact-finding groups are playing in the present emergency. But to be a little more specific I might mention that one important committee of the National Academy is advising the Office of Production Management on the availability of strategic materials.

In order to formulate adequate rules for the utilization of materials of whatever sort, accurate knowledge as to their availability, as to new processes suggested for producing them, as to possible substitutes, and a thousand and one other basic questions must be answered. This can only be done by highly trained scientists and engineers. Only after they have answered can the urgent problems or proper utilization be handled. The academy has assembled a group of the most distinguished men in the United States to give OPM this basic information.

Other examples are to be found in the services which the National Academy of Sciences and National Research Council are giving in advising the military departments on highly confidential matters; in the fact that the Medical Division of the National Research Council is the operating arm of the Medical Research Committee mentioned later, and in the service the council is furnishing in selecting technical personnel.

Thus, in June, 1940, the National Defense Research Committee, more familiarly known as the NDRC, was born. It was constituted of eight members, two of these being high-ranking men from the Army and Navy, respectively, five more being civilians well known for their experience in organizing and directing both fundamental and applied scientific research, and as an eighth member, the Commissioner of Patents.

The Executive Order creating the NDRC omitted any reference to the biological sciences, and, in particular, to the medical sciences. However, during its first year of operation, experience accumulated to the effect that a broader program of attack would not only be useful but was, in reality, urgently demanded. This realization prompted a second approach to President Roosevelt, with the result that in June of last year he created two new functional groups. One of these was the Committee on Medical Research, to explore its indicated territory in the same manner that the NDRC had been exploring the physical sciences. Then, over and above both the NDRC and the Committee on Medical Research, there was placed the Office of Scientific Research and Development, usually referred to as OSRD. This latter office was placed in charge of Dr. Vannevar Bush, who until then had been chairman of the NDRC. President Conant of Harvard was then made chairman of the NDRC and Dr. Newton Richards, of the Medical School of the University of Pennsylvania, was made chairman of the CMR.

In order to insure complete coordination of civilian and military research and development, Dr. Bush, as director of OSRD, was provided with an advisory council consisting of the chairmen of NDRC, CMR and NACA; the coordinator of naval research and the special assistant to the Secretary of War performing a somewhat similar function in that service.

The Executive Orders creating these various committees naturally had to leave indeterminate the question of financial support. They are all subsidiary to the Office for Emergency Management and, like this office, must look to Congress for the necessary operating appropriation. Thus far the appropriations, while not munificent, have been adequate. During its first year of existence the NDRC authorized research projects which totaled about ten million dollars. At the beginning of its second year, it was granted another ten millions and this was recently augmented by several millions more. To be more specific, the OSRD, during its first year of existence, will guide the expenditure of about twenty millions throughout the whole scientific field.

I should now like to take a few minutes of your time to explain the manner in which the expenditure of these funds is initiated and supervised. To begin with, let me point out that the work of the NDRC is divided into four major departments: Division A, of which Professor R. C. Tolman, of the California Institute of Technology, is chairman, deals with armor, bombs and ordnance, in general; Professor Roger Adams, of the University of Illinois, heads Division B on chemistry; Division C deals with transportation and communication and submarine warfare, and I am its chairman (this division operates the subsurface warfare laboratories); finally, Division D, which deals with instruments and numerous miscellaneous projects difficult to catalogue, is headed by President Compton, of the Massachusetts Institute of Technology. It is in this division that the micro-wave laboratory is organized.

To expedite discussions, surveys and the general handling of the work, a further breakdown has been found desirable, the result being that each division comprises several so-called sections. Division B on chemistry, under Professor Adams, is divided into thirty-one sections—which stands to date as a sort of record.

The work of a section is entrusted to a section chairman, who in turn calls to his aid certain individuals who become permanent members of his sectional committee and who are known technically as members. Then there are others who may be asked to render advice and assistance from time to time and hence are called consultants. Members and consultants are officially appointed by the chairman of the NDRC and are designated only after official clearance by the Army and Navy Intelligence and the FBI. Full consideration is therefore given to the basic requirements of the military services as regards the confidential handling of their problems. Because of its peculiar interest to you, I would note that the section dealing with communication problems is under the direction of Dr. Jolliffe, who is a vice-chairman of Division C. Neither the five civilian members of the NDRC itself nor any of the section chairmen, members or consultants are paid from public funds. Without exception, they are loaned to the Government by their employing organizations and frequently the loan is complete, the work being so voluminous and detailed as to require a man's full time. Thus, when I tell you that about 500 of the leading scientists of the country are encompassed in the present NDRC organization, you will see that the Federal Government and even the forgotten taxpayer are getting a lot of valuable consulting talent free of charge.

So far as I have now outlined it, the functioning of the NDRC requires no public money except a very small amount for paid office assistants together with the traveling expenses of members and consultants. For the most part members and consultants do not carry on the research and development projects which the NDRC decides to promote—their duties are advisory and administrative. They formulate the problems which they believe it important to have undertaken, and then arrange with various scientific institutions to carry on the work. It is this last step which brings in the need for considerable sums of money. For instance, a project assigned to a particular university or industrial laboratory may require the full time of several of its faculty together with that of numerous younger men hired specifically for the work in hand.

The number of such projects now approved and, for the most part, contracted out to universities and industrial research laboratories stands around 600, while the number of contracting institutions is over 100; and when it is stated that the total value of the projects thus far determined upon is upwards of twenty million dollars, you will realize at once that the monetary resources of the scientific world would not be adequate to conduct the program on a gratuitous basis. The contracts vary all the way from those involving a few thousand dollars to those calling for two to three hundred thousand dollars per month. I have no doubt but that many of you here to-day are working either full or part time on one or more of these NDRC contracts.

The question is frequently asked as to how many technical people have been drawn into the civilian defense effort which the NDRC directs, but obviously this is quite difficult to estimate, let alone to enumerate in detail. I have already mentioned that there are about 500 scientists in the NDRC organization serving as members, consultants, etc. It seems likely that somewhere between two and three thousand scientists are at work on defense projects as employees of contractors with about an equal number of less highly skilled individuals assisting them as laboratory assistants, technicians, etc. Then, if the situation which

I know to exist at the Bell Telephone Laboratories is to be taken as a criterion, we must add to this scientific group another very considerable array of technical people who call themselves engineers as opposed to physicists and chemists—an array which if enumerated would no doubt total four to five thousand.

Recent figures from the Bell Telephone Laboratories might be of interest as perhaps typifying the situation found in a number of industrial laboratories which are fulfilling defense contracts, some for the NDRC and some directly for the Army and Navy. A rough count shows that about 600 of our technical staff are now engaged directly on a full-time basis on defense projects. When I say that they are "engaged directly" on defense projects, I am excluding those who by circumstances arising out of the defense program have been forced to devote themselves to such problems as the finding of substitute materials and the engineering of emergency telephone projects.

Another aspect of the NDRC plan of operation which I should like to stress is its "no profit" feature. This applies alike to contractors and to employees of contractors. Perhaps this point can be brought out most clearly by reference to a specific situation. The University of California is acting as a contractor to the NDRC on a large project which involves an annual expenditure of around one million dollars. Certain members of the California faculty are employed on a full-time basis on the project and in switching from teaching to defense work have incurred no change in rates of pay. The university has also hired from other faculties certain individuals to augment the defense staff and they, likewise, have gone over without changes of salary, although a payment is made to compensate for the cost of moving in the case of both single and married men. It is also stipulated explicitly that the university, as contractor, will derive no monetary profit from the work and the same requirement is exacted of industrial laboratories and other types of contractors.

The "no profit no-loss" proposition has involved the adoption of certain more or less arbitrary but seemingly equitable rules of accounting. Thus, a university is usually allowed an overhead payment amounting to 50 per cent. of the salaries which it pays to its members employed on a defense project. Similarly, an industrial laboratory, by virtue of the fact that it has to operate with commercial capital and is subjected to a variety of forms of taxation from which the university is exempt as well as other expenses, is allowed an overhead of 100 per cent. of the salary item.

I suppose it depends upon one's point of view as to whether the effort I have just outlined appears large or small. On the one hand, it seems fairly certain that it is only a beginning and must expand further. On the other hand, it is certainly large already when contrasted with any civilian effort which was able to assert itself during the last war. And looking back to the situation which existed a quarter of a century ago, it is difficult to understand why the then available civilian agencies were not unleashed to an extent commensurate with their obvious capabilities. True, the National Research Council was created to assist with the solution of defense problems, but it was, as I have pointed out, in the position of a doctor waiting for clients; it could not adopt the attitude of an aggressive salesman and initiate attacks on what it regarded to be important military problems. Hence we can declare that as regards organization notable progress has been made.

As to future expansion of our civilian defense effort, it is becoming increasingly essential to bear in mind the potential shortage of trained personnel. Without insinuating anything as to guilt, the chemists declare that this is a physicist's war. With about equal justice one might say that it is a mathematician's war. The visible supply of both physicists and mathematicians has dwindled to near the vanishing point, consistent with the maintenance of anything like adequate teaching staffs in our universities. If this civilian defense effort is to expand, and such indeed now seems *imperative, the limiting factor may therefore* be a shortage of highly trained individuals and not a shortage of financial aid.

This leads me to state a few general observations concerning the past and future of our work. It is quite apparent that to date the burden of NDRC contracts bears much more heavily upon some institutions than upon others. At the outset this has necessarily been the case. While serious attention has at all times been given to the subdivision of projects so that they could be farmed out as widely as possible, a limit is frequently reached beyond which it isn't practicable to go in the matter of division. And in many cases, no division at all could be entertained, a situation that has given rise to a few large contractors, of which I cited the University of California as an example.

In the assignment of the early contracts, it has been natural, in fact essential, to lean heavily upon those institutions, both academic and industrial, which for one reason or another have been peculiarly fitted to transfer quickly from peace-time to war-time problems. This has been done with a view to conserving time. But the stages of the program to follow will doubtless involve a broader survey of the situation to find locations where new problems can be lodged with a minimum of interference to essential defense work and teaching now in progress. In this survey a guiding principle will be to utilize men and facilities *in situ* whenever possible, thus preserving the "going value" of groups who are accustomed to working together. In the face of crises, the human tendency is usually to do the reverse, it being so easy for central agencies to ignore established but not well-known organizations, and attempt to cope with an emergency by calling workers from right and left to some new location. As a matter of fact, this tendency was beginning to make an appearance even as long as two years ago, when the fundamental plan of the NDRC was under discussion. Had the tide then setting in been allowed to run on for some months unimpeded, the result would inevitably have been a literal army of uprooted scientists in Washington and other central points, sitting around idly waiting for vast amounts of research equipment which had been placed on order, but was not much nearer materialization than that, to be installed in hastily constructed laboratories. This would have been the easy and disastrous way. Fortunately the creation of the NDRC came in time to stem such a tide.

Another present problem, and it is the last with which I shall trouble you, is one which by its existence supplies evidence that real progress has already been made in some of the research programs thus far initiated. It has to do with shortening the time gap between proven laboratory research results and the stage where mass production can be undertaken. Some of the laboratory results already achieved hold such promise that every day which intervenes before their wide-spread utilization becomes a serious matter. Obviously the problems to be met here cover a wide range of equipment and materials—as wide as that marked out by the scientific results themselves—and since they involve large-scale manufacture, the whole plan must be carefully worked out with other official agencies, particularly the Office of Production Management and the armed services. I am sure, however, that we are prepared to meet and solve these problems, and rather than be concerned with the difficulty of making progress along this avenue, I think all who are guiding the work of the NDRC would exclaim to the ranks of scientists and technicians, "Bring on your results, the more the better, and we will guarantee them a speedy passage to the firing line!"

In the foregoing, I have attempted merely to sketch the set-up of organized civilian research and development created for the war emergency. Obviously, it is only a part of the total effort which is being mobilized. It would be unfair to thousands of scientists and engineers to infer that the main results were dependent on the work of these agencies.

The scientific departments of the armed services are being greatly enlarged; industrial laboratories are turning more and more of their efforts to direct and indirect war work and engineers everywhere are active. Fundamental and applied science are on the march.

OBITUARY

HARRY WARD FOOTE

IT is with real recognition of the responsibility which is placed upon the writer, a colleague of Harry Ward Foote in the department of chemistry in Yale University, that this report is made. This academic association covered a period of forty-two years of collegiate activity. Hundreds of graduates of the Sheffield Scientific School who enjoyed the privilege of studying chemistry under this inspiring teacher will be grieved to learn of his sudden death on January 14, 1942, in the New Haven Hospital. There were only eight days difference in the ages of Professor Foote and the writer, and we both grew up together in the atmosphere of Yale, and were taught by the same group of inspiring Yale teachers in chemistry: Professor Horace L. Wells, analytical chemistry, Professor William G. Mixter, general chemistry, and Professor Samuel G. Penfield, mineralogy.

Harry Ward Foote will be remembered as a most successful teacher in his special subjects, namely—general and analytical chemistry. He was the kind of a teacher that every American college boy should come in contact with during his academic or collegiate career. He endeared himself to his undergraduate students; he tried to understand each individual man in his class; he played fair with them, and the student was impressed with his spirit of fairness and square dealing. He was a sane thinker, not given to making snap decisions; his advice was sound and helpful. He exercised vigilance and conservatism in the trying days of Yale's reorganization of the university's departments of chemistry, and was recognized for his safe counsel and departmental cooperation.

Professor Foote's courses in chemistry laid an excellent and sound foundation for future growth; widened the student's knowledge and outlook, and encouraged many to get scientific training for themselves. Not only the student body suffers a real loss in the death of Professor Foote, but also the general faculty and departmental staff of the Sheffield Scientific School. He was recognized by his teaching associates as a good representative of democracy, a believer in freedom of speech, thought and action, as long as no infringement was made on the rights of others.

He was an excellent companion with a variety of personal interests and always a man of stability.

Collegiate institutions have learned to rate at its true worth the teaching service of men like Professor Foote, and their ability to give sound training in special fields of science. We need more than ever during these critical times young men who can apply successfully the technique of sound pedagogics. This calls for the ability to inculcate habits of keen observation and deduction; to teach the essential facts having a direct bearing on the activities of everyday life, and stimulate progressive thought during the next fifty years.

Harry Ward Foote was born in Guilford, Connecticut, on March 21, 1875. He received his degree of Ph.B. from Yale in 1895, and his Ph.D. degree from Yale in 1898. He was appointed an instructor in 1898 and served as assistant professor of chemistry from 1904–1912, and as professor of chemistry from 1912 to the time of his death. He was a fellow of Silliman College, a member of the scholastic Society of Sigma Xi and an honorary member of Chi Chapter of the chemical fraternity, Alpha Chi Sigma. He was a member of the following scientific societies, namely —American Chemical Society, Connecticut Academy of Arts and Sciences and the Royal Geographical Society. For several years he was associate editor of the *American Journal of Science.*

TREAT B. JOHNSON

YALE UNIVERSITY

PAUL STILWELL McKIBBEN

1886–1941

DR. PAUL S. MCKIBBEN, until recently dean of the School of Medicine, University of Southern California, was born in Granville, Ohio, on March 14, 1886, and died in Los Angeles, California, on November 11, 1941. His parents were George F. McKibben, professor of Romance languages in Denison University, and Elizabeth Stilwell McKibben, a graduate of Wellesley College, a very kindly and strong character. Paul McKibben's education was obtained in the public schools of Granville, Doane Academy and Denison University, where he was graduated in 1906, a bachelor of science with honors in zoology. He was appointed a fellow in anatomy in the University of Chicago in October, 1907. Professor C. Judson Herrick, who had been professor of biology in Denison University before going to the University of Chicago, was a great friend of the elder McKibbens. This friendship was shared by the younger McKibben when he went to Chicago, and under Herrick's direction and kindliness, McKibben's scientific qualities developed. This resulted in the production of one of the great anatomists, teachers and administrators of this generation. Paul S. McKibben received the degree of doctor of philosophy in June, 1911, and was immediately made instructor in anatomy at the University of Chicago.

In 1913 Dr. McKibben was offered and accepted the professorship in anatomy at the University of Western Ontario. The department of anatomy soon became the outstanding department of the Medical School. From March, 1918, for one year, Dr. McKibben was first lieutenant in the U. S. Army attached to the Neuro-Surgical Laboratory of the Johns Hopkins University where, in association with others, he did some original work on brain injuries. On his return to the University of Western Ontario, he was appointed acting dean and, because of his outstanding administrative abilities, was soon made dean. A new Medical School building was constructed largely through Dr. McKibben's efforts. Even the design was his, and it is considered one of the finest and best-equipped medical buildings in Canada. Dr. McKibben realized the advantages of a good library with the result that the University of Western Ontario Medical Library now has over 30,000 volumes. The School of Public Health was established during his deanship, mainly through his efforts. His work at the University of Western Ontario was a major factor in the development of one of the outstanding medical schools in Canada. He was very strong for the integration of primary subjects with the clinical.

In 1927 Dr. McKibben was appointed professor of anatomy at the University of Michigan, where he remained for two years. He was called in 1929 to the chair of anatomy in the newly established Medical School of the University of Southern California. In 1931 he was made dean of the School of Medicine but continued as chief of the department of anatomy. Here again his great administrative ability came to the fore and he gathered together a fine group of teachers in both the pre-clinical and clinical years.

Dr. McKibben's knowledge of medicine in general was tremendous. His ability to pick students was uncanny. He combined the qualities of a great mind with those of an outstanding teacher and administrator and, above all, was a tolerant and understanding friend to many fortunate people. Dr. McKibben was given the honorary degree of LL.D. from the University of Western Ontario in 1928 and Sc.D. from Denison University in 1936. He was a fellow of the Royal Society of Canada, the American Association of Anatomists, the American Association for the Advancement of Science, and was a member of Beta Theta Pi, Gamma Alpha, Phi Rho Sigma, Phi Beta Kappa and Sigma Xi. He leaves his widow, Elizabeth Kendall McKibben, whom he married at Baltimore while doing research at the Johns Hopkins University, four children, Paul Stilwell, Jr., Richard Kendall, John H. and Elizabeth, as well as a host of tremendously loyal and admiring friends.

JOHN MACKENZIE BROWN

SCHOOL OF MEDICINE,
UNIVERSITY OF SOUTHERN CALIFORNIA

DEATHS AND MEMORIALS

DR. HERBERT FOX, professor of comparative pathology at the University of Pennsylvania and director of the William Pepper Laboratory of Clinical Medicine, died on February 27 in his sixty-second year.

REGINALD PELHAM BOLTON, consulting mechanical engineer; president and chairman of the board of the Electric Meter Corporation, New York City, died on February 18 in his eighty-sixth year.

DR. JAMES JOSEPH WALSH, professor of physiological psychology at Cathedral College, New York, and medical director of the School of Sociology at Fordham University, died on February 28 in his seventy-seventh year.

DR. PARKE REXFORD KOLBE, president of the Drexel Institute of Technology, Philadelphia, died on February 28, at the age of sixty years.

Two Eggleston Prizes in botany at Dartmouth College have been established in memory of Willard W. Eggleston, an authority on plants poisonous to stock on the western ranges of this country.

A CEREMONY in memory of Polish professors who lost their lives as a result of the German occupation of Poland recently took place at the Royal Institution, London, under the presidency of Sir David Ross, vice-chancellor of the University of Oxford. Tribute to their work was paid by Sir William Bragg, formerly president of the Royal Society; by Professor Gilbert Murray, of the University of Oxford, and by Professor Antoni Jurasz, dean of the Polish Medical School at the University of Edinburgh.

SCIENTIFIC EVENTS

NATIONAL PARKS AND RESERVES IN GREAT BRITAIN

A PRELIMINARY memorandum on "Nature Preservation in Post-War Reconstruction" has been issued in Great Britain by a conference which, under the chairmanship of Lord Onslow, has been considering the matter since June. It is stated in the account given by the London *Times* that the conference came into being as a result of the announcement that Lord Reith had appointed a committee on the use of land in post-war planning. The organizations taking part are the following:

Association of Municipal Corporations, British Association, British Ecological Society, British Museum (Natural History), British Ornithologists' Union, British Trust for Ornithology, County Councils Association, Geological Society, Linnean Society, Royal Entomological Society, Royal Society for the Protection of Birds, Society for the Preservation of the Fauna of the Empire, Society for the Promotion of Nature Reserves, Urban District Councils Association and Zoological Society.

The memorandum states that there are three distinct needs—the preservation of (*a*) rural amenities; (*b*) forest areas as a part of the nation's resources; and (*c*) the natural fauna and flora for the advancement of scientific knowledge and education. In the view of the conference there are four ways in which these needs can be met:

1. National parks, providing facilities for the recreation of the public with no more restriction than is essential to preserve their amenities.
2. Forest and wild life reserves, to which the public would be admitted, subject to necessary restrictions.
3. Areas in which further development would be prohibited or drastically restricted. Here the existing movement of the public would not be interfered with, but additional facilities would not be provided.
4. Nature reserves or sanctuaries, from which the public would be excluded, except by permit for study.

It is pointed out in the *Times* that in some instances all these needs could be met in the same area. Areas of the first three types must be large. Those of the fourth type could be much smaller, usually measurable in hundreds or tens of acres, or even less. The conference makes the recommendation that "The provision of such areas should be among the matters comprised in National Planning."

The later part of the memorandum gives more detailed consideration of each type of area, and in regard to the first urges that the recommendations of the "Report of the National Park Committee," issued by the Stationery Office in 1931, should be put into effect.

Nature reserves should be selected upon an ecological basis, and should be of different types, such as fen, moorland, mountain, cliff, beach, woodland, and so forth, so that the typical animals and plants of each kind of country would be preserved. Some of these reserves could form part of the larger schemes for national parks and areas protected from development.

An official body should be appointed to draw up detailed proposals upon this highly technical problem of nature reserves, the control of which should be in the hands of a central body. The management of the national parks might, it is suggested, be in the hands of local bodies, acting under two national park authorities (one for England and Wales and the other for Scotland) responsible for general policy.

The conference remains in being. Its honorary secretary, Dr. G. F. Herbert Smith, Society for the Promotion of Nature Reserves, British Museum (Natural History), London, S.W.7.

CHEMICAL ABSTRACTS

Chemical and Engineering News gives the following account of the work of *Chemical Abstracts*, published by the American Chemical Society:

> In spite of war *Chemical Abstracts* published more abstracts in 1941 than in 1940. The small increase (505 abstracts) is to be attributed to success during 1941 in the abstracting of European chemical patents after overcoming difficulties which interfered with this abstracting for a considerable period after the outbreak of war in Europe. The 1941 volume contained 5,541 more abstracts of patents and 5,036 fewer abstracts of papers than in the 1940 volume. The abstracts for 1941 total 52,764 in number as contrasted with 52,259 abstracts published in 1940. Of the 1941 abstracts 35,588 are of papers and 17,176 are of patents.
>
> *Chemical Abstracts* endeavors to cover the chemical literature of the world completely. World-wide warfare presents many serious handicaps in this effort. *Chemical Abstracts* did not approach completeness so closely in 1941 as in normal years. Nevertheless, the record for 1941 is good. Abstracts from many of the papers published during 1941 in the warring or conquered European countries were obtained by some success in getting the needed periodicals (good success until Russia's entry into the war closed the trans-Siberian route), by searching this country for periodicals received in one library or another, and by having abstracts made in Europe, particularly in Switzerland and Germany, and sent by clipper ship.
>
> In general, the policy of *Chemical Abstracts* is to publish informational rather than merely descriptive abstracts. Special emphasis has been placed on this for European and other publications not readily accessible to most Americans at the present time. The average page of *Chemical Abstracts* in 1941 contains 11.5 abstracts of papers or 18.6 abstracts of patents. The corresponding figures for 1940 are 12.1 and 18.0, respectively.
>
> The edition of *Chemical Abstracts* averaged approximately 15,000 copies during 1941.
>
> The much-used list of periodicals abstracted by *Chemical Abstracts*, with its key to library files, is normally published in revised form every five years. The list was due for revision in 1941, but the war has made postponement necessary. Satisfactory revision with American libraries in their present war-handicapped condition is not possible. The *Chemical Abstracts* office is keeping as well informed as possible concerning scientific periodicals and is willing to help users of abstracts locate full papers whenever possible. Hundreds of inquiries are answered monthly.
>
> The only editorial change during the year was the well-earned elevation of Charles L. Bernier to an associate editorship following the regretted resignation of Janet D. Scott, who left to join the Chemical Warfare Service staff at Edgewood, Md. Miss Scott is continuing to help in the naming and indexing of inorganic compounds. The editor gratefully acknowledges the valuable help of all of the assistant editors and abstractors, many of whom are continuing their work for *Chemical Abstracts* in spite of heavy national defense assignments. Our work is regarded as being in the same category.

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology will meet in Boston from March 31 to April 4. The general chairman of the meeting is Dr. Albert G. Hogan, University of Missouri, and the general secretary is Dr. Donald R. Hooker, the Johns Hopkins University. The following table gives the date of meeting of the constituent societies, and the names of the presidents and secretaries.

SOCIETY	PRESIDENT	SECRETARY
	April 1 to 3	
American Institute of Nutrition	Dr. Albert G. Hogan University of Missouri	Dr. Arthur Smith Wayne University
	April 2	
American Physiological Society	Dr. Philip Bard The Johns Hopkins University	Dr. Carl J. Wiggers Western Reserve University
	April 2 to 4	
American Society of Biological Chemists	Dr. Rudolph J. Anderson Yale University	Dr. Arnold K. Balls George Washington University
	April 2 to 4	
American Society for Pharmacology and Experimental Therapeutics	Dr. E. M. K. Geiling University of Chicago	Dr. Raymond N. Bieter University of Minnesota
	April 2 to 4	
American Society for Experimental Pathology	Dr. Jesse L. Bollman Mayo Clinic, Rochester, Minn.	Dr. H. P. Smith State University of Iowa

PHI LAMBDA UPSILON

THE results of the recent election of the national officers of Phi Lambda Upsilon, honorary chemical society, are announced in the January issue of the *Register*, the official publication of the society. Professor William M. Sandstrom, of the department of agricultural biochemistry of the University of Minnesota, was reelected president. Professor T. F. Buehrer, head of the department of agricultural chemistry of the University of Arizona, and for twelve years national secretary-treasurer, was elected to the vice-presidency. Both men have long been identified with the national activities of Phi Lambda Upsilon.

Professor L. F. Audrieth, of the University of Illinois, was reelected editor of the *Register*. Dr. C. S. Carlson, assistant professor of chemical engineering at the University of Pennsylvania, and Professor Herschel Hunt, of Purdue University, were chosen for the offices of secretary and treasurer, respectively.

Phi Lambda Upsilon has enjoyed a remarkable growth since it was founded at the University of Illinois in 1899 as a society for the promotion and recognition of high scholarship and achievement in the field of chemistry. Only seven collegiate honorary organizations antedate the founding of Phi Lambda Upsilon. There are now thirty-eight chapters with an active and alumni membership exceeding 11,000.

For many years Phi Lambda Upsilon has recognized outstanding American investigators by election to honorary membership. During the past year two distinguished chemists have been awarded this distinction—Dr. Linus C. Pauling, director of the Gates and Crellin Laboratory at the University of California and Nobel Laureate, and Professor William Lloyd Evans, retired head of the department of chemistry at the Ohio State University and president of the American Chemical Society.

THE CHARLES FREDERICK CHANDLER MEDAL OF COLUMBIA UNIVERSITY

FOR outstanding achievements in chemical science, Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories, New York, and Dr. Roger J. Williams, of the University of Texas, received on February 26 awards of the Charles Frederick Chandler Medal of Columbia University. This is the first double award of the medal since it was established in 1910.

Dr. Robert R. Williams was cited for "his years of work on the isolation of vitamin B_1 and his contributions to the elucidation of its chemical structure." Vitamin B_1, which Dr. Williams synthesized and named thiamin, is the antineuritic beriberi vitamin, vital to nerve health and life.

The award to Professor Roger J. Williams was made in recognition of his discovery of pantothenic acid, powerful regulator of growth popularly known as "the acid of life," and for his contributions to the knowledge of the vitamin B complex.

The medal ceremony was held in the Horace Mann Auditorium. Dr. George B. Pegram, dean of the Columbia Graduate Faculties, presented each recipient with a certificate in lieu of a gold medal, presentation of which will be postponed until after the war. The university, as part of its conservation policy, has discontinued striking bronze, silver or gold medals during the war period.

Vitamins will increase intelligence and morality as well as give people better physical and mental health, was stated by Dr. Roger J. Williams in a joint discussion on "Vitamins in the Future." He pointed out that "Since an ample supply of vitamins can foster a higher intelligence in human subjects, it has also the capability of fostering morality. Recent studies, several of them in New York City, have shown without question that intelligence and morality go together."

Discussing novel approaches to the treatment of diseases by chemical means, Dr. Roger Williams described a new "definite guiding principle" that chemists may follow in their investigations. He said:

> It seems a reasonable working hypothesis to assume that chemical substances which have striking physiological effects have these effects because of their resemblance to naturally occurring tissue constituents. Continuing, we may assume that many substances of potential therapeutic value will be found which bear chemical resemblances to the various vitamins, of which we now have a considerable variety.
>
> If these remarks are valid, chemotherapy can now develop, not in a hit-and-miss and entirely empirical fashion, but by making use of at least one definite guiding principle.
>
> One of the most important applications of vitamin knowledge will be, I believe, to the study of cancer. Our work as well as that of others indicates that the vitamins in the diet make a difference in cancers other than those induced by butter-yellow.

All the vitamins which are required to check the great nutritional plagues of mankind have already been discovered and produced commercially. Dr. Robert Williams stated that:

> The lesser vitamins, if we may call them such for the sake of brevity, may afford us, however, great revelations regarding physiological and even pathological processes and so must be classified as lesser only in a narrowly defined sense.
>
> The point in distinguishing between major and lesser vitamins is one which concerns present-day technology, present-day economics and present-day sociology. I should like to divert the minds of food processors, teachers of nutrition, practicing physicians and laymen from speculating about the latest surmise of vitamin science and persuade them to devote their major energies to the intelligent application of the vitamins which stand in the front row on the shelf.
>
> It is high time we should be systematically eradicating the long known deficiency diseases. The first impulsion of our present knowledge of vitamins and their essential roles should be to promote restoration of values lost to the masses by these restrictions. A general removal of economic restraints would largely achieve the result because appetites lead to diversity when income permits.
>
> This, however, is a Utopian ideal far beyond our immediate reach. Education, if universal, would largely accomplish the result, for avoidance of refinement is not inherently costly. However, education of the most needy

elements is exceedingly slow and difficult. We must, therefore, turn to more effective weapons as soon as education has pervaded the public mind sufficiently to permit their employment.

Legislation in the United States prohibiting the sale of impoverished white bread and flour is a possibility. Undoubtedly any attempt to prohibit the sale of white wheat products in the United States would meet with insuperable public opposition. However, it is now possible to add artificially the principal valuable vitamins and minerals of wheat at a cost of something less than twenty-five cents per capita per annum.

Increased economic productivity of the bulk of the population would repay the cost perhaps a thousand-fold to say nothing of improved health and sense of well-being. Yet this great reform is being sabotaged or damned with faint praise by half the nutritionists of the country on the ground that it would be still better if we could arrange breakfasts of ham and eggs, whole wheat buns and a glass of milk for everybody. Of course it would, but shall we wait for the millennium to take our first steps to mass repair of our nutritional errors?

Pending the day when such legislation can be secured and the necessary scientific methods of control are developed, we must look largely to the food industries for correction of our dietary faults. These industries have been made very conscious of their public obligations, to a great extent through the operation of the pure food laws during recent decades. Within the limits of practicality, they are in general ready to cooperate in such reforms on a voluntary basis.

You are doubtless asking what all this vitamin knowledge will get us in terms of health, strength and longevity. No quantitative estimates are possible. Very few long-term experiments with animals have been carried out since all the major vitamins became available in pure form and since several of the lesser ones have been at least recognized. The testimony of the clinics, the results of experiments with school lunches or supplementary feeding, as well as the observation of health trends in nutrition-conscious populations, are very reassuring.

Since partial deficiencies are often most apparent in middle or later life when the body mechanism is beginning to feel the strain of the years, it seems reasonable to hope that nutritional reform will extend the span of life measurably. Control of infectious disease has principally affected mortality in infancy and early life. Those who survive to old age tend to be those who have acquired immunity to infectious disease or at least to have undergone a selection for resistance to disease. In nutritional disease, the phenomenon of immunity is absent. We do not grow accustomed to deficiencies with the years. Early damage remains and later damage accumulates till the slowing bloodstream of age leaves our cells grossly undernourished, so it seems.

When nutritional reforms have been in full operation for some years, the physician will have little occasion to treat deficiencies of the major vitamins. Until that happy day, which must be some years hence, he will encounter an abundance of avitaminoses, especially in clinics for the under-privileged. His immediate task is to recognize the symptoms.

SCIENTIFIC NOTES AND NEWS

The American Education Award of the American Association of School Administrators was presented on February 24 at the San Francisco meeting to Dr. Robert A. Millikan, chairman of the Executive Council of the California Institute of Technology, as "a tribute to and in recognition of outstanding contributions made in the broad field of education."

The Longstaff Medal of the Chemical Society of London has been awarded to Dr. Hugh S. Taylor, David B. Jones professor of chemistry and chairman of the department at Princeton University. The medal is conferred every three years upon a fellow of the society "who, in the opinion of the council, has done the most to promote the science of chemistry by research."

The Wollaston Medal of the Geological Society, London, has been awarded to Professor R. A. Daly, Sturgis Hooper professor of geology in the Museum of Comparative Geology at Harvard University, "in recognition of his fundamental researches in many branches of geology, especially those concerned with the origin of igneous rocks, the constitution of the interior of the earth and the controls of coral-reef formation."

The *Journal* of the American Medical Association reports that Dr. Juan P. Garrahán, a pediatrician of Buenos Aires, has been awarded the 1941 prize of the Academia Nacional de Medicina of Buenos Aires for his article on "Prothrombin, Vitamin K and Hemorrhages in New-born Infants." The prize was established by the academy in memory of the Argentine pediatrician, Dr. Juan Carlos Navarro, who died in 1936.

Presentation of the gold medal of the Society of Women Geographers was made on February 23 at the annual meeting of the society in New York to Dr. Margaret Mead, assistant curator of ethnology at the American Museum of Natural History.

Officers of the Society of Economic Paleontologists and Mineralogists have been elected as follows: *President,* Herschel L. Driver, Standard Oil Company of California, Los Angeles; *Vice-president,* Parker D. Trask, U. S. Geological Survey; *Secretary-Treasurer,* H. B. Stenzel, University of Texas.

Professor Raymond E. Davis, of the College of Engineering of the University of California, was installed as president of the American Concrete Institute at the close of the Chicago meeting. He succeeds Admiral Ben C. Morell, of the United States Navy.

AT Fordham University, the Reverend Francis W. Power, S.J., has been promoted to a professorship in chemistry.

DR. ROBERT H. SHULER, of the University of Chicago, has been appointed assistant professor of physiology at the School of Medicine of the University of Georgia.

DR. RONALD F. BROWN, instructor in chemistry at Purdue University, was promoted to an assistant professorship of organic chemistry at the beginning of the second semester of the University of Southern California.

DR. JAMES L. MORRISON, instructor in pharmacology at the West Virginia University School of Medicine, has been appointed instructor in pharmacology at the Medical School of Emory University.

DR. ELSIE S. L'ESPERANCE has been placed at the head of a new cancer-prevention clinic for women at the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York. She is a member of the board of managers of the hospital and is one of the founders of the Kate Depew Strang Tumor Clinic at the New York Infirmary for Women and Children.

DR. LEONA BAUMGARTNER, pediatrician, who has been acting director of the Bureau of Child Hygiene of the New York City Health Department, became director of the bureau in January.

THE Borden Vitamin Company announces that Dr. Hugh H. Darby, research assistant in the department of biochemistry of the College of Physicians and Surgeons of Columbia University, has joined the staff for research and development in the production and application of vitamins and hormones.

DR. ROBERT S. BREED, head of the division of bacteriology of the New York State Agricultural Experiment Station at Geneva, has leave of absence in order to conduct a survey of dairy research and education in South America for the Inter-American Committee for the Dairy Industry.

MEMBERS of the faculty of the University of Michigan who are serving under the National Defense program include in the sciences: Elmore S. Pettyjohn, associate professor of chemical and metallurgical engineering; Walter C. Sadler, professor of civil engineering; Jesse Ormondroyd, professor of engineering mechanics; Robert B. Hall, professor of geography; Preston E. James, professor of geography, and Samuel A. Goudsmit, professor of physics.

DR. MAXWELL E. LAPHAM, dean of the School of Medicine of Tulane University of Louisiana, has left for Washington to work in the Bureau of Medicine and Surgery, U. S. Navy. In his absence Dr. Hiram W. Kostmayer, director of the department of graduate medicine, has been appointed acting dean.

DR. W. R. HUTCHERSON, head of the department of mathematics at Berea College, Kentucky, has been granted leave of absence which he is spending at Brown University on a defense mechanics fellowship. His work at Berea College will be carried on by Professor D. W. Pugsley; Dr. Waldemar Noll, head of the department of physics, is teaching in the College of the City of New York.

DR. WILLIAM J. ROBBINS, of the New York Botanical Garden, gave on February 26 a lecture before the Lancaster Branch of the American Association for the Advancement of Science. His lecture, which was illustrated with colored motion pictures, was entitled "Plant Life in a Botanical Garden."

DR. DONALD D. VAN SLYKE, of the Rockefeller Institute for Medical Research, New York City, and Dr. Warfield T. Longcope, professor of medicine at the Johns Hopkins University, gave the Abraham Flexner lectures at the School of Medicine of Vanderbilt University. Dr. Van Slyke spoke on the "Physiology of the Kidney" and "Renal Function in Diseases of the Kidney" on February 2 and 3, and Dr. Longcope on "Clinical Nephritis" on February 5 and 6.

A SYMPOSIUM entitled "What Is Research?" was presented on February 20 at a meeting in New York City of the American Section of the Society of Chemical Industry, held jointly with the American Institute of Chemical Engineers. Dr. Lincoln T. Work, director of research of the Metal and Thermit Corporation, presided over the meeting and introduced the subject "Research," which was discussed "from the Consultant's Viewpoint" by Frank G. Breyer, of Singmaster and Breyer; "from the Industrial Viewpoint" by Dr. George O. Curme, Jr., vice-president of the Carbide and Carbon Chemicals Corporation; and "from an Institutional Viewpoint" by Dr. L. W. Bass, assistant director of research at Mellon Institute.

THE thirteenth annual meeting of the American Association of Physical Anthropologists will be held at Harvard University on April 16, 17 and 18. Two symposia are planned, one for Thursday on "Fossil Man and Primates" and one on Friday on "Techniques and Interests of Physical Anthropologists." The annual dinner will be given on Friday, and will be followed by a motion picture of Point-Hope Eskimos which will be presented by Dr. H. L. Shapiro.

THE three hundred and eighty-sixth meeting of the American Mathematical Society will be held at Columbia University, New York City, on Friday and Saturday, April 3 and 4. On Friday afternoon, there will be a symposium on topics in the theory of functions, consisting of two addresses, "On Entire Functions of Exponential Type," by Dr. R. P. Boas, of Duke University, and "On the Zeros of the Derivatives of a Function and Its Analytic Character," by Professor George Polya, of Smith College. The discussion leaders are Professors Norman Levinson, of the Massachusetts Institute of Technology, and I. J. Schoenberg, of the University of Pennsylvania. A symposium on aeronautics is being arranged for Saturday afternoon. One of the speakers will be Dr. Theodore Theodorsen, of Langley Field, Virginia, whose subject is "Theory of Wing Flutter." The discussion leader will be Professor Willy Prager, of Brown University.

THE next general meeting of the International Association for Dental Research will be held in the Commodore Hotel, New York City, on March 14 and 15. It will be followed by a meeting of the American Association of Dental Schools which will be held on March 16, 17 and 18.

AN examination for appointment as assistant sanitary engineer in the Regular Commissioned Corps of the U. S. Public Health Service will be held at Washington, D. C.; Cincinnati, Ohio; New Orleans; Kansas City and San Francisco, at 9 A.M. on May 11. Candidates must be not less than twenty-three years nor more than thirty-two years of age on that date and must have had at least seven years of educational (exclusive of high school) and professional training, or experience equivalent thereto; and shall have graduated from a reputable professional school granting a degree in engineering (sanitary engineering course). In addition the applicant will be required to pass a satisfactory physical, academic and professional examination. Commissioned officers are not appointed to any particular station, but to general service. They are subject to change of station as the exigencies of the service may require and shall serve wherever assigned to duty. Compensation, including allowance for quarters and subsistence, will be $3,158 and $2,699 for officers with and without dependents, respectively.

THE American Library Association has established a Committee on Aid to Libraries in War Areas, with John R. Russell, librarian of the University of Rochester, as chairman. After the first World War there was difficulty in completing foreign institutional sets of American scholarly, scientific and technical periodicals. The attempt to avoid a duplication of that situation is now the concern of the committee. Many sets of journals will be broken by the financial inability of the institutions to renew subscriptions. Many more will have been broken through mail difficulties and loss of shipments and the destruction of libraries. The size of the eventual demand is impossible to estimate. In so far as possible, sets will be completed from a stock of periodicals being purchased by the committee. With an imminent paper shortage, attempts are being made to collect old periodicals for pulp. Fearing this possible reduction to the already limited supply of scholarly and scientific journals, the committee hopes to enlist cooperation to prevent the sacrifice of this type of material. Information in regard to the project can be obtained from Wayne M. Hartwell, executive assistant to the Committee on Aid to Libraries in War Areas, Rush Rhees Library, University of Rochester, Rochester, N. Y.

THE Science-Technology group of the national Special Libraries Association has undertaken to compile, for the benefit of users of the Russian scientific and technical periodicals, current or otherwise, a complete list of the holdings of such periodicals in all the libraries of the United States and Canada, so far as possible, whether personal, institutional or industrial. Owners and librarians in charge of such materials are asked to cooperate by sending a detailed statement of their holdings to Miss Nathalie D. Frank, 512 West 162nd Street, New York City. It should be stated whether or not the journals can be borrowed on interlibrary loan and whether the library has facilities for photostating or microfilming.

THE Executive Committee of the National Parks Association met recently in Washington and agreed upon the importance of carrying on its educational program. It is planned to continue advocacy of National Primeval Parks as a distinct category, to promote worthy park projects that have already been authorized, to encourage appreciation and proper use of America's natural and historic heritage, to combat each threat of commercial encroachment upon our protected reservations, and to divert destructive uses of all kinds from this country's superlative natural areas.

THE newly established French School of Higher Learning has opened its courses in the building of the New School for Social Research. Professor Boris Mirkine-Guetzevitch gave his first lecture on the constitutional history of France, beginning with the French revolution; Professor Fred G. Heffherr spoke of the history of French civilization, and Professor Georges Gurvitsch, of French sociology. All lectures are given in French. The school has at present a faculty of letters and a faculty of law and a special institute of Oriental and Slavic studies. The faculty of science under Professor Jean Perrin will be organized later.

DISCUSSION

EXTENDED THEOREMS IN DYNAMICS

THE Faraday lines of force in any field of force constitute a familiar geometric pattern. Less well known because of its intrinsic complexity is the geometry of the trajectorial curves[1] (the paths of mass particles moving in the force field). Of course these two geometries should be related, but precisely how may we compare the two families of curves? This is what we propose to indicate.

Let a particle start from rest. The path obtained in this manner we shall call a "rest trajectory." Obviously this curve has the *same direction* as the Faraday line through the given point, but in general, since the mass particle has inertia, the two curves will *not coincide*. In fact, the only instance in which coincidence can occur is the trivial case in which both curves are straight lines. Omitting this possibility, there are always two distinct curves. The rest trajectory and the line of force will agree as to initial direction, but differ in initial curvature; the trajectory will be between the line of force and the common tangent line. The quantitative relation connecting the two curves is given in the following theorem discovered by Kasner in 1904 and since proved in many ways:

Theorem I:[1] *If a particle starts from rest in any positional field of force, the initial curvature of the trajectory is one third of the curvature of the line of force through the initial position.*

There are two important manners in which this proposition may be extended. The theorem is universally valid, but its significance is slight if the curvature of the line of force is zero at the point. If the curvature is zero, as for example at a point of inflection, the same is true of the curvature of the trajectory, and a separate discussion, involving a closer scrutiny of the situation, is necessary. In this case we study the ratio of the infinitesimal departure of the path and the line of force from the common tangent line. In the general case this ratio would be $1:3$ as stated above, because in the usual case the ratio of departures is the same as the ratio of curvatures. But in the special case of zero curvature, the ratio (which now depends on the rates of change of curvature) is found to be $1:5$, $1:7$, $1:9$, etc., depending on the order of contact of the line of force with the tangent line. The precise dependency is stated in Theorem II.

Theorem II:[2] *If the Faraday line of force has contact of order n with the tangent line, the rest trajectory will also have contact of n^{th} order; and the limiting ratio of the departure of the trajectory to the departure of the line of force from the common tangent line is* $1:2n+1$.

The second manner in which Theorem I may be generalized is to acceleration fields of higher order. A particle of unit mass is said to be moving in an acceleration field of order r if

$$\frac{d^r x}{dt^r} = \varphi(x, y) \qquad \frac{d^r y}{dt^r} = \psi(x, y)$$

where $\varphi(x, y)$ and $\psi(x, y)$ are the rectangular components of the higher acceleration field acting at the point (x, y) and t is the time. By definition, a particle will start from "maximum rest" in such a field if the initial velocity and the initial accelerations of order up to and including $r-2$ are zero (that is, all derivatives up to order $r-1$ vanish). What is the analogue of Theorem I for such higher fields?

Theorem III:[3] *If a particle starts from maximum rest in an acceleration field of order r, the initial curvature of the trajectory is* $\frac{r!\,(r-1)!}{(2r-1)!}$ *times the curvature of the line of force through the initial position.*

Now allow the particle to start from maximum rest in an acceleration field of order r, at a point at which the curvature of the Faraday line of force may be zero (the case in which Theorem III would no longer be significant). What is the appropriate ratio of departures?

Theorem IV: *In an acceleration field of order r, at a point at which the line of force has n^{th} order contact with its tangent line, the trajectory produced by starting a particle from maximum rest also has contact of order n with the tangent line; and the limiting ratio of the departure of the trajectory to the departure of the line of force from the common tangent line is* $\frac{(n+1)\,(r)\,!\,(nr)!}{(nr+r)\,!}$.

We see that all three situations previously discussed in Theorems I, II and III are now included in the single final Theorem IV. Indeed, the first three theorems become corollaries of this new result. For $r=2$, the newtonian case, the ratio is $1:2n+1$, as stated in Theorem II. For r arbitrary and $n=1$, the case in which the curvature does not vanish, we obtain the ratio of Theorem III, namely $\frac{r!\,(r-1)!}{(2r-1)!}$. And for $r=2$ and $n=1$, we have the standard dynamical Theorem I, with the usual ratio $1:3$.

All our theorems, although originally stated for two dimensions, remain valid for any number of dimensions, and in any riemannian space.

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[1] E. Kasner, "Differential Geometric Aspects of Dynamics," Princeton Colloquium, 9, 1909, new edition 1934.

[2] *Idem*, *Proceedings of the National Academy of Sciences*, 20: 130–136, 1934.

[3] E. Kasner and D. Mittleman, *Proceedings of the National Academy of Sciences*, Feb., 1942.

Theorem I has been applied[4] to the study of the famous deviation problem (a particle falling from rest to the earth allowing for rotation or ellipticity). Our new extended theorems will also have applications, direct and indirect, in physical situations dealing with interacting particles. The forces need not be conservative.

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A STUDY OF LAMPBRUSH CHROMOSOMES BY THE ELECTRON MICROSCOPE

LAMPBRUSH chromosomes have been photographed by the electron microscope. The nuclei were removed from the oocyte according to the method of Duryee[1] and were placed on the collodion film suspended on the wire mesh which is used in place of the slide in the electron microscope. The nuclei were torn apart so that the enclosed material spread over the film. The membrane was then removed since it was too thick for penetration by the electron beam when collapsed. The preparation was allowed to dry in air.

The photographs seem to verify early descriptions. Some chromosomes appeared to be highly branched and subbranched. They were fern-like in appearance. The threads were crystalline and single. Other chromosomes showed less numerous, thicker, more globular side branches. Many side branches had been lost between the first and second type. Finally some showed no branches. There were as many as four threads twisting about one another separating into twos at some points and rejoining at others.

No loops, as described by Duryee, were seen. However, chromosomes from full-sized eggs only have been examined. Further investigations, in which the nuclei of half-sized eggs will be used, are in progress. It may be that these will verify the loop theory as put forth by Duryee.

Blanks were run in which only cell debris, from which the nucleus had been removed previously, and the nuclear salt solutions were dried and photographed. No similarities between these preparations and those of the nucleus were observed.

The investigations are being extended in the belief that they will throw added light on the structure of such chromosomes and will clear up such problems as the time at which the chromomena thread becomes doubled.

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CONSIDERATION OF THE ADEQUACY OF BIOMICROSCOPY AS A METHOD OF DETECTING MILD CASES OF VITAMIN A DEFICIENCY

RECENTLY Dr. H. D. Kruse has reported on "The ocular manifestations of avitaminosis A with especial consideration of the detection of early changes by biomicroscopy."[1] He has suggested that "xerosis conjunctivae probably precedes night blindness as an early sign of avitaminosis A," and recommends biomicroscopic examination as a "simple, convenient, objective method" for the detection of avitaminosis A in surveys.

In view of the importance of finding reliable tests for detecting mild degrees of the various avitaminoses, it is relevant to call attention to certain discrepancies between the above-mentioned observations and those reported in a study by Booher, Callison and Hewston in which impaired dark adaptation was produced in five adults by the consumption of a diet adequate in every known dietary essential except vitamin A.[2] The Hecht and Shlaer Adaptometer was used to determine the dark adaptation curves of these subjects. Dysadaption occurred in from 16 to 124 days after the vitamin A-deficient diet was begun and for four subjects was allowed to proceed until the visual threshold after 30 minutes of dark adaptation was elevated by 1 logarithmic unit; subject I of this group was continued on the experimenal diet until the 30-minute threshold was 4 logarithmic units above normal, while at this time of greatest visual impairment, the rod structures were not functioning at all below the scotopic threshold of the cones. Thus, there was no question of the existence of hemeralopia in any of the five subjects.

During the period of greatest impairment in retinal function, a slit-lamp examination was made on subject I by Dr. Alan C. Woods, of the Wilmer Ophthalmological Institute of The Johns Hopkins Hospital. There was no evidence of abnormality. The remaining four subjects were examined with the slit-lamp by Dr. William M. Rowland of the same institution both before and during impaired adaptation, as well as after that function had returned to normal following the administration of moderate amounts of vitamin A. Neither did any of these subjects show conjunctival or corneal changes at any of the examinations.

Attention should also be called to the work of Youmans *et al.*, who conclude that mild degrees of vitamin A deficiency can exist without any modification of the ocular epithelia, as diagnosed by microscopic examination of conjunctival smears.[3] Similar observations have been made in this laboratory.

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[4] W. H. Roever, *Bull. Amer. Math. Soc.*, 456, 1915.

[1] W. R. Duryee, "Cytology, Genetics and Evolution," University of Pennsylvania Press, Philadelphia, 1941.

[1] H. D. Kruse, *The Milbank Memorial Fund Quarterly*, 19: 207, 1941.

[2] L. E. Booher, E. C. Callison and E. M. Hewston, *Journal of Nutrition*, 17: 317, 1939.

The cases reported by Dr. Kruse were obtained from a low-income group of which a dietary survey was being made. In such a group multiple dietary deficiencies are the rule rather than the exception. Therefore, it is important that further investigation of conjunctival and corneal changes be made on subjects with uncomplicated experimental vitamin A deficiency before complete reliance is placed in the biomicroscopic examination as a routine method of detecting mild cases of vitamin A avitaminosis.

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SOME FACTORS IN THE NUTRITIONAL DETERMINATION OF HISTORY

IN his paper concerning the social implications of vitamins, Williams[1] suggested that the enjoyment of a more generous supply of thiamin and other vitamins by the Germans than by other peoples of Western Europe might explain the present European situation. Thiamin has also been referred to by others as "the morale vitamin." However, I am inclined to agree with Clendening[2] that the importance of vitamins in national nutrition is being grossly exaggerated. False hopes of simple solutions of nutritional problems appear to be raised by an over-emphasis on the value of vitamins. Indeed, it remains to be seen whether the use of "enriched" foods and vitamin preparations will do much more in the long run than increase the incidence of obesity, diabetes and other disorders promoted by over-nutrition.

The developments in Europe during the past 25 years nevertheless seem to present excellent illustrations of the effects of some nutritional factors, independent of the vitamin supply, on the rise and decline of nations or cultures throughout the ages. That is, a nation or culture can develop only when or where a sufficient supply or surplus of food becomes available. In a society with constructive or progressive tendencies, a sufficiency or surplus of food serves, in part at least, to provide leisure for some to develop the arts. Among even the most primitive arts has been that of catering to the appetite. This art has conspicuously manifested itself in tribal feasts, in the Roman banquets and, in recent Europe, by French cuisine. The Roman banquets probably sealed the fate of the Roman Empire and French food and wine were very likely factors in the fall of France. In short, too much food or an excessive catering to the appetite can wreck an empire just as surely as it can ruin an individual.

On the other hand, seasonal variations in the food supply, periodic famines, wars and more or less fasting under religious influences in the past apparently served to avert an otherwise precipitate decline of some nations or cultures because of the common tendency to self-indulgence in the midst of plenty. Thus, in India and China, a relatively steady state or balance between the supply or use of food and cultural attainment has long been maintained. In the first World War, German resistance cracked partly because of simple undernourishment due to the food blockade and, shortly after that, Russia came close to complete collapse because of famine conditions in that country. However, it does not seem to be sufficiently realized that the outburst of the German spirit since the first World War and the recent stubborn resistance of the Russians to invasion are explainable as physiological and psychological consequences of more liberal food supplies following periods of enforced food restriction or starvation. The observations of Carlson,[3] Kunde,[4] Glaze[5] and McCay[6] indicate that a manifestation of physical and/or mental improvement is to be expected with re-alimentation after periods of fasting or food restriction. Moreover, the results of my personal experience, which involves a total of about 600 days of fasting during the past 33 years and also some observations on others, lead me to believe that the most striking after-effects of fasting or food restriction occur between the ages of about 20 and 35. In the German and Russian experiences, this means in those who are now between about 40 and 60 years of age and therefore in active control.

If the foregoing views are correct, it would seem of more importance in America to guard against the insidious effects of dietetic excesses among the "well-fed" millions than to concentrate on raising the nutritional standards of the extremely poor. In any case, so-called deficiency diseases may often be excess diseases—due to excessive intakes of carbohydrates, fats and/or proteins. I believe that a sufficiently keen appetite is about all that is needed to lead one to choose an adequate diet and that the appetite can best be kept keen by occasional periods of voluntary food restriction or fasting. More studies ought to be made on the after-effects of fasting and simple undernutrition. Undoubtedly, many a conscientious objector to military service would be willing to volunteer for such nutritional study.

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[3] J. B. Youmans, M. B. Corlette, M. G. Corlette and H. Frank, *Jour. Lab. and Clin. Med.*, 23: 663, 1938.

[1] SCIENCE, 94: 502, November 28, 1941.

[2] *Jour. Am. Med. Assn.*, 117: 1035, 1941.

[3] "The Control of Hunger in Health and Disease." Chicago. 1916.

[4] *Jour. Metabolic Research*, 3: 399, 1923.

[5] *Am. Jour. Psychol.*, 40: 236, 1928.

[6] "Chemical Aspects of Aging." In Cowdry, "Problems of Ageing." Baltimore. 1939.

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FALSE BLOSSOM IN PERIWINKLES AND ITS CURE BY HEAT

ONE of the chief difficulties in the study of false blossom has been the lack of a host in which the disease could be reproduced as it occurs in the cranberry which, for various reasons, is not a good experimental plant. Under the stimulus of finding a favorable host in which to observe the efficacy of heat treatments for cure of false blossom, attempts were made to transmit virus from cranberries to periwinkles (*Vinca rosea*). The parasite, *Cuscuta campestris* Yuncker, which had been shown to transmit certain other viruses,[1] was used. It proved to be an efficient vector. Through its parasitic activities, false blossom was taken to periwinkles and also to potato, tomato, tobacco and *Nicotiana glutinosa* plants. Under favorable conditions the disease appeared in periwinkles within about one month after exposure to the parasite. The virus was readily transmitted in all the new hosts by grafting.

False blossom periwinkles were cured easily by heat treatments. Exposures at 40° C for one week cured the tops but not the roots, but exposures for two weeks cured both tops and roots. Diseased periwinkles were able to endure the treatments without serious injury. Whether false blossom can be cured in the cranberry has not yet been determined. Experiments designed to test this possibility are in progress. In its reaction to heat in periwinkles, false blossom virus behaves similarly to that of aster yellows.

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SCIENTIFIC BOOKS

SINANTHROPUS PEKINENSIS

The Extremity Bones of Sinanthropus Pekinensis. By FRANZ WEIDENREICH. *Paleontologia Sinica* New Series D. No. 5. 82 pp. 20 tables. 34 plates. Peking, 1941.

THIS latest paper in the long series of studies of the *Sinanthropus* material by Dr. Weidenreich had received only a sparse distribution in the United States before the outbreak of war halted its importation. Because of the tremendous interest attaching to the Choukoutien remains, as well as the inaccessibility of many of the accounts dealing with the material, a summary may be useful.

Unfortunately the Peking calvariae have not been accompanied by a similar abundance of arm or leg bones. So far we possess only seven fragments of femur, two of the humerus, one of the clavicle and one carpal bone: the *os lunatum*. Nevertheless, these remains are such as to permit observations concerning their general evolutionary status.

In the case of the femur, Dr. Weidenreich believes the material justifies the conclusion that *Sinanthropus* was short in stature, approximating the average of the present-day Eskimo or Japanese. The structure of the bone betrays certain distinctive traits. The medullary canal of the shaft is, for example, very narrow and the walls correspondingly thick—much more so than in modern man. Neanderthal femora are more rugged, and the degree of forward bending of the shaft in this latter form is much more pronounced than in the Peking type. In these two respects, *Sinanthropus* approaches *sapiens* more closely than does *neanderthalensis*. All in all, some nine minor characters are noted as more or less distinctive and apparently specific for *Sinanthropus*. Nevertheless, the femur is definitely human in character, and there is no doubt that Peking man walked erect. The proportions, the presence of a linea aspera, and the position of the gluteal tuberosity, are definitive upon this point.

The humerus, also, is of human character. As in the case of the femur, a few minor peculiarities are noticeable. They are, however, features occasionally to be observed in modern man. The humero-femoral index, which expresses the length of the humerus as a percentage of the length of the femur, is indicated at about 79. This falls in the existing human range, whereas in the anthropoids the index ranges well over 100. An index of 79 is thus amply suggestive of the essentially human and upright posture of *Sinanthropus*.

The semi-lunar wrist bone or *os lunatum* is similarly human, though its height-breadth and length-breadth indices are variant in an anthropoidal direction. The clavicle is seemingly more akin to modern man than that of *neanderthalensis*.

There seems no doubt, in view of the above evidence, that Dr. Weidenreich's contention that man had already assumed an erect posture, in other words was a bipedal ground-dwelling primate before his skull and dentition had been so extensively modified in a human direction, is fully acceptable.

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[1] Folke Johnson, *Phytopath.*, 31: 649, 1941.

Expressing the opinion that *Pithecanthropus* and *Sinanthropus* can, at best, be regarded as no more than racially distinct, Dr. Weidenreich is sharply critical, justifiably so in the eyes of this reviewer, on the inadequacy of our present nomenclature in relation to the taxonomy of the Hominidae. Obviously it demands revision. He also argues on the basis of the Choukoutien femur fragments that the famed Trinil thigh bone can not possibly represent the same individual as the *Pithecanthropus* calvarium. In addition he reaffirms his belief in the Mongoloid affinities of *Sinanthropus*.

Irrespective of the eventual settlement of some of these perennial and favorite subjects of debate, the value of Dr. Weidenreich's contributions upon the subject of fossil man can not be overemphasized. He has been as prompt as is consistent with scientific accuracy in issuing reports; in wealth of anatomical detail and comparison with other fossil forms, his studies have lifted human paleontology to a new level of attainment. In all these matters the present monograph maintains the same high standard. One hopes that further publications may be undertaken here in the United States and that the exigencies of war will not completely interrupt, at least in terms of laboratory study, the intensive exploitation of the most remarkable body of material yet acquired on the human history of the earlier Pleistocene.

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WATER-SUBSTANCE

Properties of Ordinary Water-Substance. American Chemical Society Monograph. By N. ERNEST DORSEY. xxiv + 673 pp., 13 figs., 289 tables. New York: Reinhold Publishing Company. 1940.

THIS book assembles all the physical constants of ordinary water-substance (excluding isotopes). Never before have they been gathered into one volume. Of course, those who need to use such constants know already that this book is indispensable, and need not be told what a masterpiece it is; but it has a wider usefulness which should be pointed out. Water is of interest not only to physicists, chemists and engineers. It is one of the fundamental substances of the universe, just as the ancients suspected. Any one who doubts this fact is referred to Dr. Dorsey's classic as proof.

This book of tables, so exhaustive, so meticulously assembled, compared, recomputed and revised (which a veteran of the National Bureau of Standards could be depended upon to produce), can be studied as a yardstick of physical science. Lincoln once explained to a jury what the word "demonstrate" meant. He said he looked the word up in the dictionary and found "to demonstrate, as a proposition in Euclid." So he got a copy of Euclid and by the time he had finished it he understood what "demonstrate" meant.

Now too many who have never had much discipline in physics are being swept off their feet by much modern jargon, which impresses them about as the squabbles of the medieval schoolmen. Too many fifth-columnists against science are exploiting this confusion to undermine public faith in the facts of physics, very often with funds exploited from scientific discovery. A perusal of this book, checking up a few of the sources, can be depended upon to produce a healthy respect for the reality of science. Thus, it provides a vista of the anatomy of science which should be viewed by every college student.

After carefully defining symbols and units, the energy constants for the synthesis and dissociation of water are presented. Then single-phase systems, water vapor, liquid water and ice, and finally multiple-phase systems and phase transition are covered in over 600 pages of tables. Each table is explained briefly, and after each are given the references to the sources of the data; but to present them in comparable form an immense amount of recomputation has been necessary, often revealing and correcting errors in previous compilations.

The purpose of these tables has been to provide the inexpert with the data he may need, explaining the formulas and methods on which they are based, and giving the means of more detailed study when desired. Any one interested, therefore, can find out immediately the status of the facts up to 1938, and search the literature himself for more recent data. The book is a monument to its author, its institution, and to the myriad devoted workers whose careful labors are assembled.

P. V. WELLS

PRINCETON, N. J.

REPORTS

THE ANNUAL REPORT OF THE DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

THE report of Dr. William J. Robbins, of the New York Botanical Garden, reviewing the four years of accomplishment of the garden since 1937, when he became director, was presented at the annual meeting of the board in January. He stated that, even though war might modify and curtail activities, the institution would, he hoped, "continue to make most effective use of those facilities and funds at our disposal, regarding them as a public trust to be used for the benefit of the public."

Fifteen men, or fourteen per cent. of those employed by the garden, are already serving with the Army and Navy, and more are expected to go. Besides this direct participation in the war, the garden is aiding in many ways in the present emergency. Dr. Robbins then described the new "victory course," in vegetable gardening, one of which is given in cooperation with *The New York Times*. Both afternoon and evening classes are to be given, a three-day short course was offered and a demonstration course in vegetable garden management. The garden will maintain a model vegetable garden out-of-doors during the spring, summer and early fall.

For the relief of present conditions in this country, the garden furnishes information on plants for industries which are suffering the loss of materials through the war.

While the garden has kept strictly within its budget during the past four years, Dr. Robbins pointed out that since its establishment and the construction, around 1900, of the main buildings, no period has witnessed such a marked improvement in material facilities as in the years since 1937. Also, notable horticultural accomplishments can be recorded, and there is evidence on every hand of greater public interest and increased service to the public. He mentioned particularly the following accomplishments:

> The number of hardy trees and shrubs in the permanent collections has been doubled.
>
> The number of kinds of plants now cultivated regularly at the Garden is more than 12,000.
>
> The educational program lately initiated and developed attracted more than 400 students last year.
>
> Attendance at the free lectures given on Saturday afternoons has more than doubled (increasing from 3,060 in 1937 to 7,000 in 1941).
>
> Subscriptions to the Garden's monthly journal have grown from 75 to nearly 700 in the past three years.
>
> Most of the conservatory displays have been replanted in naturalistic fashion. Also, the main conservatories were almost entirely rebuilt. (They were first constructed 40 years before.)
>
> The Garden's 280 acres were completely surrounded by a fence for the first time.
>
> Much reconstruction was done in the Museum Building, including installation of a reception room for members.
>
> Considerable new construction was added to improve the facilities for growing plants.

Arrangements for a new base plan for the future development of the garden have been completed. Major Gilmore Clarke is now working on the plan, which has been made possible through the generosity of Mrs. Harold I. Pratt, a member of the Board of Managers. The fencing of the grounds in 1940 has made necessary a number of changes in landscaping and in traffic routing.

Accomplishments of the year 1941 include:

> Beginning of construction of a walled experimental garden for the use of members of the scientific staff.
>
> Receipt of many thousands of plants as gifts, a number of them extremely rare, and among them the Forster collection of nearly 10,000 orchids valued at $75,000; 2,000 cactus plants from the Government of Mexico; and a total of 4,000 bulbs, orchids and other plants from two individual donors.
>
> Nearly 50,000 individual plants set out (chiefly in front of the Main Conservatories and the Museum Building) for bedding effects in the spring and summer. These included 10,000 tulips saved from the display of the previous year, which had been a gift of the Holland Bulb Industries.
>
> More than 4,000 shrubs planted on the grounds, including large numbers of rhododendrons, flowering cherries, barberries, lilacs, evergreens and other ornamentals. New labels required for these and other plants in cultivation at the Botanical Garden during the year totaled more than 5,400. Of these 49 were of the informational type, placed mostly beside plants of economic usefulness.
>
> Addition of 36,747 herbarium specimens to the scientific collections, bringing the total of this important reference collection of preserved plants to 2,056,296 specimens, comprising the largest herbarium under one management in the United States.
>
> Addition of books to bring the total bound volumes in the library close to the 50,000 mark.

Officers of the garden, all reelected for the current year, are: Joseph R. Swan, *President;* Henry De Forest Baldwin and John L. Merrill, *Vice-presidents;* Arthur M. Anderson, *Treasurer;* and Henry de la Montagne, *Secretary*.

SPECIAL ARTICLES

NARCOTIC POTENCY OF BIURETS CONTAINING PIPERIDINE

HILL and Degnan[1] noted that 1-diethylacetyle-5,5-cyclopentamethylene biuret has hypnotic properties and comparatively low toxicity. Following a different chemical procedure than previously employed, 4 additional biurets have been synthesized.[2] These are:

---

[1] A. J. Hill and W. M. Degnan, *Jour. Amer. Chem. Soc.*, 62: 1595, 1940.

[2] C. H. Ch'eng and Peter P. T. Sah, in preparation.

1-diphenyl-5-phenyl biuret (m. p. 134° C.), 1-phenyl-5,5-pentamethylene biuret (m. p. 153° C.), 1,1-pentamethylene-5,5-pentamethylene biuret (m. p. 198° C.), and 5,5-pentamethylene biuret (m. p. 121° C.).[3] All derivatives are crystals and the first 3 are poorly soluble in water or alcohol. One per cent. water solution of 1,1-pentamethylene-5,5-pentamethylene biuret may be made by heating and keeping the solution at 37° C.

The monopiperidine biuret is less toxic for mice than sodium barbital, sodium pentobarbital or sodium dilantin but more toxic than paraldehyde. The LD_{50} for mice is 600 mg/kg on intraperitoneal injection. This amount antagonizes a surely fatal dose of picrotoxin and usually of strychnine but does not protect mice against cocaine.[4] Hypnotic doses of the biuret in rabbits of 60 mg/kg given intravenously slightly depress blood pressure and cardiac rate during the injection only, but do not affect respiration or uterine activity.[5] Inhibition of uterine strips, from humans and rabbits occurs in dilutions of 1:2,500 to 1:5,000 *in vitro*. It is 30 and 10 times less potent than sodium dilantin and sodium pentobarbital, respectively. The total oxygen uptake of rat liver during a 60-minute period is depressed approximately 35 per cent. by the monopiperidine biuret, 0.1 gm/100 cc; 75 per cent. by sodium pentobarbital, and inappreciably by paraldehyde and sodium barbital.[6]

Dipiperidine biuret is even less toxic for mice, the LD_{50} being 1,250 mg/kg on intraperitoneal injection. It is less active as an antagonist of chemicals affecting different levels of the central nervous system. It antagonizes cocaine convulsions but does not save mice given lethal amounts; no protection against strychnine convulsions is provided, and all picrotoxin-treated mice had convulsions after an LD_{50} dose of this biuret but none died. In rabbits, narcosis follows intravenous injections of from 100 to 200 mg/kg without appreciable effect on respiration, on blood pressure except during the injection, or on the blood sugar during or following narcosis. Uterine activity *in situ* is inhibited with these doses. *In vitro* tests indicate that smaller concentrations of the dipiperidine than of the monopiperidine biuret are inhibitory. Dilutions of 1:7,500 to 1:10,000 for human uterine strips and from 1:15,000 to 1:20,000 for rabbit strips are effective. In this respect the dipiperidine biuret resembles sodium pentobarbital. Depression of oxygen consumption of rat liver follows exposure to 0.1 gm/100 cc of this agent for 60 minutes.

Since the dipiperidine derivative has pharmacologic activities similar to sodium pentobarbital, except that it is 1/10 as toxic, the narcotic potency at various dose levels was studied in inbred white mice and inbred white rats. The graph indicates the duration of narcosis in mice after intraperitoneal injection in single or divided amounts. Preliminary studies after oral administration to rats provided similar data. At the onset of narcosis there is no excitement and during the depth of narcosis respiration is more regular and less depressed than noted in pentobarbital treated animals.

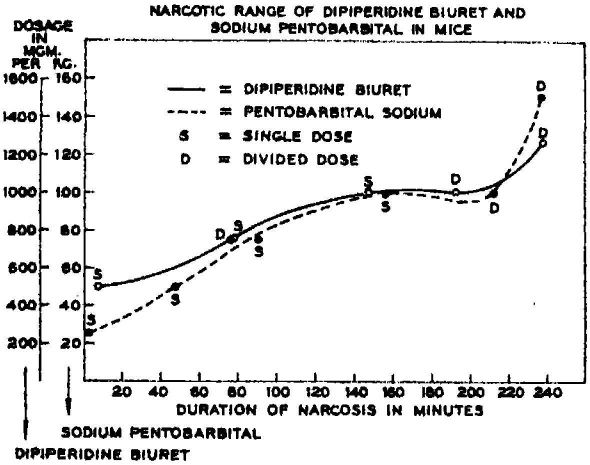

Fig. 1.

Preliminary observations on the effect of the dipiperidine biuret in 60 and 120 mg/kg doses intravenously in the rabbit at term indicate that fetal respiratory movements are not significantly affected by these amounts.[7]

Summary: Five biurets, 4 containing piperidine, have been prepared and various pharmacologic activities of 2 have been studied. The monopiperidine derivative effectively antidotes picrotoxin and strychnine, while the dipiperidine biuret is life-saving to mice given lethal doses of picrotoxin. Uterine activity and the oxygen consumption of rat liver are depressed more by the dipiperidine biuret. Neither derivative appears to be as toxic as commonly used hypnotics or anticonvulsants with which a comparison was made, except paraldehyde. Narcosis of mice, rats and rabbits produced by the dipiperidine biuret resembles that of pentobarbital but is less disturbed.

---

[3] We are grateful to Dr. Stanley Wilson, Yenching University, for checking nitrogen determinations of these compounds.

[4] C. H. Ch'eng, H. H. Anderson and S. Y. P'an *Jour. Pharmacol. and Exper. Therap.*, 72: 7, 1941; H. H. Anderson and S. Y. P'an, *Proc. Soc. Exp. Biol. and Med.*, 46: 611, 1941.

[5] S. Y. P'an and C. S. Lu, *Chin. Jour. Physiol.*, 16: 311, 1941.

[6] S. Y. P'an and C. S. Lu, in press.

[7] K. T. Lim, personal communication.

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FLUORINE ACQUIRED BY MATURE DOG'S TEETH[1]

THE post-eruptive deposition of fluorine in the enamel[2,3,4] and dentine[3,4] of molar teeth of young rats has been reported. A similar study on a mature dog supports this finding particularly with regard to the dentine. At the beginning of this study a two-year-old mongrel dog with full dentition had three representative teeth extracted. Sodium fluoride was then given via food and drinking water for definite periods, each period terminating with the extraction of two or three comparable teeth. Food and drinking water were consumed ad libitum. The pooled teeth representing each period of exposure to fluoride were separated into dentine and enamel and analyzed for ash and fluorine.

TABLE I

EFFECT OF EXPOSURE TO FLUORIDE ON THE FLUORINE CONTENT OF THE DENTINE AND ENAMEL OF A MATURE DOG'S TEETH

Pooled teeth sample number		I	II	III	IV	V
Age of dog at time teeth were extracted.	(days)	730	796	900	1,145	1,289
Total number of days exposed to fluoride in food and water prior to tooth extraction	(days)	0	66	170	415	559
Exposure to fluoride immediately prior to tooth extraction.						
Fluoride in food and water	(ppm)	0	15	45	100	500
Total time fed	(days)	0	66	104	245	144
Composition of dentine						
Ash	(per cent.)	71.90	71.88	73.15	73.35	73.21
Fluorine	(per cent.)	.018	.022	.039	.059	.072
Composition of enamel						
Ash	(per cent.)	95.20	95.75	95.72	96.32	95.96
Fluorine	(per cent.)	.006	.007	.009	.007	.011

The results for each successive sample of dentine show that the mature dentine increased in fluorine decisively. The enamel does not show a similarly consistent nor equal percentage-increase. The final sample of enamel, however, contained 0.011 per cent. fluorine as compared with 0.006 per cent. fluorine in the initial or control enamel. In this connection it is interesting to note that the enamel of carious human teeth and the enamel of non-carious human teeth have been reported to contain 0.0069 per cent. and 0.0111 per cent. fluorine, respectively.[5] A distinction possibly may be made in tooth fluoride acquired post-eruptively and fluoride which is acquired during the formative period of the tooth.[3,4] Fluoride given during gestation and lactation to mother rats, *i.e.*, during the period of tooth formation in their young, appears to diminish susceptibility to caries in the offspring.[6] There is certain limited epidemiological evidence with respect to human dental caries,[7] which seems to agree with this latter finding in rats.[6]

These results for the dog's teeth and similar results based on young rats[2,3,4] advance speculation regarding post-eruptive chemical modification, as a property of calcified dentine and enamel. Fluoride retention may prove a useful tool in studying individual variations in dentine and enamel in relation to tooth age and susceptibility to dental caries. In the results for the enamel fluoride the property of the enamel to adsorb fluoride on the oral surface[2] may receive further support, although a systemic retention via the dentine can not be discounted.[3,4]

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FURTHER NOTES ON THE INCUBATION PERIOD OF THE PEACH MOSAIC VIRUS[1]

ADDITIONAL information regarding the seasonal spread of peach mosaic from diseased to healthy trees and the incubation period of the causal virus has been obtained during the 1941 growing season.

Seeds from "natural" peach seedlings are used in our experimental plots because the virus of peach mosaic is not transmitted through the seed of the peach.[3] Seeds were planted in November, 1940, at Whitewater, Mesa County, Colorado. On May 15, 1941, the seedlings were approximately from 4 to 6 inches in height. On this date Elberta peach nursery trees in this area were well leaved. Twenty feet to the west of the seedling plot, which totaled approximately 400 trees, was a row of 30 three-year-old Elberta trees affected with the severe strain of the peach mosaic virus. Fifteen of the seedling trees on August 25, 1941, showed symptoms of the severe strain of the peach mosaic virus. These symptoms were evident in the new growth. Under these conditions of natural spread the incubation period was approximately 100 days or less and the spread of the disease occurred in the spring. This natural spread of the disease has never been observed in one-year-old Elberta peach trees in commercial orchards. It has been recorded in only a very few instances in the past in two- and three-year-old Elberta trees.[3]

---

[1] The author is indebted to Passed Assistant Dental Surgeon Francis A. Arnold, Jr., for assistance in the experimental work.

[2] M. W. Perry and W. D. Armstrong, *Jour. Nutrition*, 21: 35, 1941.

[3] F. J. McClure, *Jour. Nutrition*, 22: 391, 1941.

[4] F. A. Arnold, Jr., and F. J. McClure, *Jour. Dent. Rsh.*, 20: page 457, 1941.

[5] W. D. Armstrong and P. J. Brekhus, *Jour. Dent. Rsh.*, 17: 393, 1938.

[6] G. J. Cox, M. C. Matuschak, S. F. Dixon, M. L. Dodds and W. E. Walker, *Jour. Dent. Rsh.*, 18: 481, 1939

[7] H. T. Dean, P. Jay, F. A. Arnold, Jr., and E. Elvove, *Pub. Health Rep.*, 56: 365, 1941.

[1] Published with the approval of the director as paper number 130, Scientific Journal Series, Colorado Agricultural Experiment Station.

Approximately the same length of time for the incubation of the virus has been demonstrated when bud and graft inoculations have been made in the spring.[2] In these latter cases symptoms of mosaic were shown by inoculated trees during the same growing season. On the other hand, trees inoculated in mid-summer or later did not show symptoms of mosaic until the following spring.

These studies re-emphasize the need for the immediate removal of all diseased trees as soon as leaf symptoms are evident.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE MECHANICAL SHAKER

A NUMBER of mechanical shaking devices are reported in the literature.[1-10] Some of these are of excellent design but involve considerable expense as well as the services of a trained mechanic in their construction. This places them beyond the means of many small projects.

Schwarz and Shapiro[9] have pointed out the advantages of the reciprocating type of shaker as compared to the rotating type, since the rapid changes in momentum of the liquid produce greater agitation. The reciprocating type, however, is subjected to considerably more strain in operation, and unless very good alignment is obtained the machine soon breaks down.

An almost ideal combination of advantages in construction, design and type of action is furnished by an ordinary sewing machine head. From it a mechanical shaker can easily be built which is compact, convenient and quite inexpensive. Following is a description of the shaker designed for use in this laboratory:

The sewing needle is detached and a thin strip of iron eight inches long by five-eighths inch wide is welded into its place. To this strip is fastened a wooden rack twelve inches long by seven inches wide. This rack is designed to hold flasks during shaking and is equipped with appropriate fittings. The wheel of the sewing machine is replaced by a pulley of desired size and the shaker is then powered by a belt drive from a 1/16 h.p. motor. The accompanying diagram (Fig. 1) illustrates its construction.

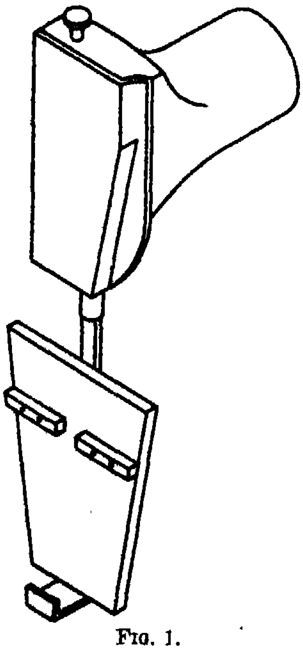

FIG. 1.

In order to reduce excessive noise and vibration at high speeds (200 strokes per minute), the shaker is made to operate against a slightly stretched screen door spring which is fastened to a stationary object (in this case the floor). A rubber eraser fastened to the shaker stand is placed so as to make a sliding contact with the flat surface of the moving flask carriage. The eraser thus acts as a guide for the carriage and effectively eliminates horizontal vibration. Care should be taken not to place too great a load on the shaker when it operates at high speeds, an audible "knock" warning the operator in such cases.

---

[2] Lee M. Hutchins, E. W. Bodine and H. H. Thornberry. U. S. Department of Agriculture Circular No. 427. 1937.

[1] Anon., *Chem. Ztg.*, 36: 679, 1912.

[2] L. B. Berchardt, F. C. Hildebrand and B. A. McClellan, *Cereal Chem.*, 15: 116, 1938.

[3] J. M. Feder, *Jour. Lab. Clin. Med.*, 23: 974, 1938.

[4] R. B. Fisher and A. E. Wilhelmi, *Biochem. Jour.*, 32: 609, 1938.

[5] Fritz Haufland, *Chem. Ztg.*, 32: 1213, 1908.

[6] Joseph H. Holt, *Jour. Lab. Clin. Med.*, 23: 533, 1938.

[7] Arthur G. Milligan, *Jour. Chem. Soc.*, 125: 674, 1924.

[8] Theodore Neustadter and Raymond Holz, *Jour. Lab. Clin. Med.*, 23: 313, 1937.

[9] E. R. Schwarz and Leonard Shapiro, *Ind. Eng. Chem., Anal. Ed.*, 10: 281, 1938.

[10] W. Steinkopf and H. Winternitz, *Chem. Ztg.*, 37: 40, 1913.

[3] E. W. Bodine and L. W. Durrell, *Phytopath.*, 31: 322–333, 1941.

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AUTOLOGOUS PLASMA CLOT SUTURE OF NERVES

Fibrin suture of peripheral nerves accomplished by the use of fortified cockerel plasma with chick embryo extract as the clotting agent has been described by Young and Medawar.[1] These authors reported encouraging results following application of the method to suture of the sciatic nerve in rabbits. In repeating these experiments, we have found considerable inflammatory reaction with fibrosis at the site of the nerve suture. Because such reaction may seriously interfere with proper regeneration of nerve fibers, we have been led to study the suitability of autologous plasma clotted with autologous muscle extract for suture of peripheral nerves. Among other advantages, the procedure has proved to be simpler than the method employing heterologous materials.

The technique consisted of exposing and cutting the sciatic nerves of rabbits, bringing the retracted stumps together with jeweler's forceps, depressing the ends so as to form a trough and adding first 5 drops of plasma and then 1 drop of tissue extract. The fluids were mixed *in situ* and about 3 drops were withdrawn into a pipette to reduce to a minimum the amount of clot remaining as suture material. Although clotting occurred in about 40 seconds, the nerve ends were held together with the forceps for 4 minutes after addition of the fluids to make certain that the clotting process was complete. When tension on the suture line was great or the clot was of poor tensile strength, separation of the nerve stumps followed withdrawal of the forceps. This occurred in about 30 per cent. of the operations.

In order to evaluate the suitability of different suture materials, comparative studies were carried out with cockerel, human and rabbit plasma. In most of the experiments, heparinized or unmodified mammalian plasma was used and fortification of the plasma by the addition of fibrinogen was omitted. When no anticoagulant was employed, the blood was drawn into a chilled syringe coated with mineral oil and immediately transferred to paraffin-lined test-tubes packed in ice. The tubes were centrifuged in 250 cc cups filled with ice. In a few instances, citrated plasma was used and clotting was induced by addition of calcium chloride and tissue extract.

Concentrated saline extracts of mouse lung and rabbit gluteus muscle were employed as clotting agents. One cc samples of plasma were coagulated in test-tubes of 8 mm internal diameter and the clots tested for tensile strength. Although great variation was found, the results indicated a superiority of mammalian over cockerel plasma. The average tensile strength found in 74 tests of human plasma was 89 grams; in 34 tests of rabbit plasma, 34 grams; in 16 tests of cockerel plasma from 4 birds, 19 grams.

Suture of the sciatic nerves was done in 27 rabbits. Rabbit plasma was employed in 19 of the sutures, while human and cockerel plasma were utilized 13 and 9 times respectively. Silk sutures and other control procedures were carried out in 11 instances. The sutured nerves were removed 2 to 26 weeks after suturing. Microscopic studies showed evidence indicating that the nerve fibers readily grow beyond the suture line into the distal end of the nerve.

These experiments have progressed sufficiently to permit the following conclusions:

(1) Rabbit plasma with rabbit muscle extract is superior to cockerel plasma with chick embryo extract for nerve suture in rabbits. The former clots possess greater tensile strength and provoke less inflammatory and fibrotic reaction.

(2) Clots obtained from human plasma cause more tissue reaction in rabbits than clots obtained from rabbit plasma.

(3) Autologous plasma clot suture of nerves in rabbits compares favorably with silk suture in the amount of resultant tissue reaction. The former moreover obviates the disadvantages of strangulation and disorganization of nerve fibers which occurs with silk suture, especially in small nerves with delicate connective tissue sheaths. When the nerve stumps are under tension, plasma clot suture is, at present, not as desirable as silk suture, since it possesses less holding power.

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BOOKS RECEIVED

Day, Chapin W. and Margaret Ritchie. *Studies and Activities in Biology.* Edited by John W. Ritchie. Pp. vi + 218. World Book Company. $0.80.

Morris, Earl H. and Robert F. Burgh. *Anasazi Basketry, Basket Maker II through Pueblo III.* 43 figures. Pp. viii + 65. Carnegie Institution of Washington. $1.50.

Philosophies of Education. Forty-first Yearbook of the National Society for the Study of Education, Part I. Edited by Nelson B. Henry. Pp. vii + 321. Public School Publishing Company.

Studies in Mathematical Economics and Econometrics in Memory of Henry Schultz. Edited by Oscar Lange, Francis McIntyre and Theodore O. Yntema. Pp. 292. The University of Chicago Press. $2.50.

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[1] J. Z. Young and P. B. Medawar, *The Lancet*, 2: 126, 1940.

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PHYSIOLOGY OF THE AMINO ACIDS[1]

By Dr. DONALD D. VAN SLYKE

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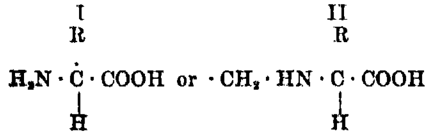
Amino Acid Structure of the Proteins. The tissues of our bodies, skin, muscle, tendon, are chiefly protein substances. The number of proteins in the animal and vegetable world appears to be infinite. Yet they are all constructed of about twenty-one units, called the amino acids. These have an extraordinary ability to link together in chains in numbers up to thousands. One definition of infinity might be the possible number of different protein molecules that could be built by permutations and combinations of the amino acids. The extraordinary thing, in fact, is that nature ever succeeds in duplicating a protein molecule. Perhaps she never does exactly. But she comes so close to it that so far as we can tell the casein of cow's milk is always the same, the proteins of muscle seem to be constant in their properties, and so on through the list of proteins that make up the familiar animal and vegetable structures of which we are constructed and on which we live.

The common structure which all the amino acids possess, and which permits this chain-making, may be formulated as:



$$\overset{\text{I}}{H_2N\cdot\overset{\displaystyle R}{\underset{\displaystyle H}{C}}\cdot COOH} \quad \text{or} \quad \overset{\text{II}}{\cdot CH_2\cdot HN\cdot\overset{\displaystyle R}{\underset{\displaystyle H}{C}}\cdot COOH}$$

All the amino acids except proline and hydroxyproline have Structure I, while these two amino acids have II. Each amino acid has an amino group, NH_2 or $NH \cdot CH_2$, which has an alkalinity about equal to that of ammonia; and each has a carboxyl group, COOH, which has the acidity of an unusually strong organic acid. The R represents a chemical group which is different in each amino acid, and gives it its character as an individual.

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[1] From an address given at the Centennial Celebration of the University of Chicago, September, 1941.

In proteins Emil Fischer demonstrated that the amino acids are joined, by what he termed peptide linkings, each NH_2 group condensing with the COOH of another amino acid, with elimination of the elements of water. Simple chains of a few amino acids, Fischer termed peptides.

The proteins are peptides of tremendously long chains. These protein chains seem usually to be rolled or folded into balls or otherwise made to take a globular or ellipsoid or sausage shape. Their rates of diffusion were found by Northrop and Anson[1] to approximate the rates that would be calculated for spheres, and the asymmetries calculated from ultra centrifugation are not great. Exceptions are the fibrous proteins, such as silk and wool, in which the molecules appear to be extended into straight wavy chains, long bundles of which make the visible fibers.

Path of Amino Acids through the Body. Except for the transient supply of proteins with which we are born, all those in our bodies are obtained from the proteins of other animals and vegetables, which we eat and digest into their constituent amino acids or simple peptides, and then build into our own tissues. However, only a fraction of the amino acids that we invite into our bodies really find acceptance there as naturalized citizens, integral units of our own structures. Many other fates beset the immigrant amino acid; it may be disintegrated to make some entirely different product; or it may simply be burned for fuel. We shall try to follow some of the paths in the body that are taken by amino acids after digestion and absorption in the alimentary tract.

Methods for Determination of Amino Acids. In studies of protein digestion and of the nature and fate of the digestion products, methods for measuring the amounts of amino acids present in blood and other parts of the body are indispensable tools. Two such methods developed in our laboratory have contributed part of the physiological information that will be discussed.

The first was the "nitrous acid method"[2] which depends on the reaction:

$$R \cdot CH(NH_2) \cdot COOH + HNO_2 = R \cdot CH(OH) \cdot COOH + H_2O + N_2.$$

The N_2 gas is a measure of the amount of amino acid present. The reaction is not entirely specific for amino acids, because other amines with NH_2 groups also react; but such amines are usually not present in important amounts or can be removed.

A later and more specific method[3, 4] depends on reaction with a mild oxidizing agent called ninhydrin. Its effect is indicated by the equation:

$$R \cdot CH(NH_2) \cdot COOH + O = RCHO + NH_3 + CO_2.$$

The analysis consists merely of heating the mixture for a few minutes and measuring the CO_2 evolved. This reaction is so specific for free amino acids that it serves to pick out and measure them in the most diverse mixtures of other amines, organic acids, peptides and other biological products.

Digestion and Absorption. In the human stomach the chief visible change, as noted a century ago by Beaumont[5] through the bullet hole in the stomach of Alexis St. Martin, is that food proteins which enter as insoluble matter, such as meat or coagulated egg white, are dissolved. Chemical studies show that the long protein chains are unrolled and broken into relatively short peptide chains, which still, however, are fairly long. No absorption of the products occurs in the stomach; absorption begins only after the chyme enters the intestine.

In the intestine the chyme meets the enzymes secreted by the pancreas and the intestinal wall. These enzymes hydrolyze the long peptides of the chyme to short peptides containing only 2 or 3 amino acids in the molecule, and to free amino acids. Also, any unchanged protein particles that have escaped the gastric juice are digested. The ability of the intestine to digest, not only gastric peptides, but also intact proteins, makes possible the nutrition of people with achylia gastrica and even of persons who have had the stomach completely removed.

Interchange of Amino Acids between Blood and Tissues. Van Slyke, Cullen and McLean[6] found that in dogs during digestion the amino acid content of the blood rose about 20 per cent, as the blood perfused the intestines, and that the greater part of the absorbed amino acids was removed by the liver. In return, the liver poured into the blood of the hepatic vein an amount of urea nitrogen which almost balanced the amino acid nitrogen that had been taken up. One could watch the work of the liver in taking up the amino acids and destroying them, turning their nitrogenous parts into urea for excretion by the kidneys. Unreasonable and wasteful though it seems, a large part of the amino acids absorbed from the intestine appears to be captured and destroyed by the liver, and never to have a chance to reach and nourish the other tissues.

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[1] J. Northrop and M. L. Anson, *Jour. Gen. Physiol.*, 12: 543, 1928–29.

[2] D. D. Van Slyke, *Jour. Biol. Chem.*, 9: 185, 1911; 12: 275, 1912; 16: 121, 1913; 83: 425, 1929.

[3] D. D. Van Slyke and R. T. Dillon, *Compt. rend. lab. Carlsberg*, 22: 480, 1938.

[4] D. D. Van Slyke, R. T. Dillon, D. A. MacFayden and P. Hamilton, *Jour. Biol. Chem.*, 141: 627, 1941

[5] W. Beaumont, "Experiments and Observations on the Gastric Juice and the Physiology of Digestion," 1833. 1929 edition. Boston.

[6] D. D. Van Slyke, *Arch. Int. Med.*, 19: 56, 1917.

Other experiments, performed with Dr. Gustav Meyer,[7] showed that the liver did not get all the absorbed amino acids, but that some escaped, and could be absorbed by other tissues. It was found that even in the fasting animal the amino acid concentration in the tissues was about 10 times as great as in the blood plasma, *viz.*, about 40 to 60 mg of amino acid nitrogen per 100 grams of tissue, compared with 5 mg per 100 grams of plasma. When amino acids were injected into the circulation they were quickly taken from the blood by the tissues, where the amino acid contents might be increased to 2 or 3-fold their former values. In one experiment the amino nitrogen of the liver rose to 150 mg per 100 grams; in the muscles the increase was never so great. During the next three hours the amino acids in the muscles and kidneys remained practically unchanged, but the amino acids in the liver fell almost back to their original level, and an equivalent of urea nitrogen appeared in the circulation.

Fate of Amino Acids in the Liver. The evidence in these experiments, that the liver is the organ where *urea formation* takes place, supported an old but much contested hypothesis that the liver is the only organ that forms urea. Its unique distinction in this power was confirmed by Bollman, Mann and Magath,[8] of the Mayo Clinic, who showed that removal of the livers from dogs led to an accumulation of amino acids in the blood, and entirely stopped the formation of urea.

Another vicissitude of the amino acids which the work of Mann and his colleagues located in the liver is *transformation into glucose.* Graham Lusk[9] in the early part of the century showed that when protein was catabolized by dogs made totally diabetic by phloridizin poisoning, about 60 grams of glucose were formed and excreted from each 100 grams of protein catabolized. Lusk and his collaborators also showed that when certain amino acids were fed their carbon was partly or entirely turned into glucose when their nitrogen was turned into urea. Mann[8] and his colleagues showed that no glucose formation from proteins or amino acids occurred when the liver was excluded.

Furthermore, the acceleration of the body's heat production that occurs during assimilation of protein digestion products was shown by Mann[8] and his colleagues not to occur when the liver was excluded. This accelerated heat production, called by Rubner the *"specific dynamic action,"* apparently either represents energy produced by the reactions which the amino acids undergo in the liver, or is caused by other reactions in the cells which are stimulated by the presence of products formed in the liver. Such substances must be other than the urea and glucose, for neither of these causes the observed amount of heat acceleration.

Not all the treatment met by the amino acids in the liver is destructive. During periods of heavy protein feeding the body stores considerable amounts of protein in the liver and, in less amounts per gram of tissue, in the other tissues. The *reserve protein* seems to be different from the structural proteins of the tissues. In the liver Berg[10] has shown that it can in fact be differentiated with the microscope by its droplet structure in the cells. Functionally it is characterized by the readiness with which it is metabolized at the onset of starvation, and with which it is used to replace blood proteins depleted by hemorrhage, as found by Whipple[11] and his colleagues.

The liver also appears to be the place where *plasma fibrin and albumin* are formed. It was demonstrated thirty years ago by Whipple[12] that injury of the liver retarded or prevented formation of fibrin. Work by the same author and others[13] has accumulated evidence that the liver is essential also for the formation of the albumin of the plasma. These proteins are presumably formed from free or combined amino acids taken out of the blood by the liver.

Transamination in the Tissues. Some of the amino acids can be synthesized in the body. One of the reactions by which the synthesis occurs has recently been discovered by two Russian biochemists, Braunstein and Kritzman.[14] It is called "transamination," and it enables the cells to change keto-acids, $R \cdot CO \cdot COOH$ to amino acids, $R \cdot CH(NH_2) \cdot COOH$ by replacing the oxygen atom of the ketone CO group with the elements of ammonia. This ammonia, however, must be transferred to the ketone acid from the $CH(NH_2)$ group of one of the dicarboxylic amino acids, aspartic or glutamic. Since at least some of the keto acids can be produced by partial oxidation of carbohydrates, transamination appears to be one of the processes by which the body can construct a portion of its own amino acids. The reaction of transamination is caused by an enzyme that occurs in all the tissues, and is rich in the muscles.

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[7] D. D. Van Slyke and G. Meyer, *Jour. Biol. Chem.*, 12: 399, 1912; 16: 187, 197, 213 and 231, 1913.

[8] J. L. Bollman, F. C. Mann and T. B. Magath, *Am. Jour. Physiol.*, 69: 371, 1924.

[9] G. Lusk, "The Elements of the Science of Nutrition," Philadelphia, 1928.

[10] W. Berg, *Biochem. Z.*, 61: 429, 1914.

[11] F. Robscheit-Robbins and G. H. Whipple, *Am. Jour. Physiol.*, 112: 27, 1935.

[12] G. H. Whipple and S. H. Hurwitz, *Jour. Exp. Med.*, 13: 136, 1911.

[13] S. C. Madden and G. H. Whipple, *Physiol. Rev.*, 20: 194, 1940.

[14] A. E. Braunstein and M. G. Kritzman, *Nature*, 140: 503, 1937; *Idem*, 144: 669, 1939. Also various papers in Biokhimia (Russian), 1937 and later.

Transmethylation. The discovery of du Vigneaud[15] that methyl groups can be transferred from methionine, $CH_3 \cdot S \cdot CH_2 \cdot CH(NH_2) \cdot COOH$, to other substances in the body has opened a field rivaling in interest that of transamination. Du Vigneaud proved that choline could be formed with the aid of methyl groups from methionine. He administered methionine in which the methyl of the $CH_3 \cdot S$ group was marked by hydrogen in the form of deuterium. When this labelled methionine was fed to rats on a choline-free diet choline could be isolated from their tissues with part of its methyl groups containing deuterium. This observation showed that methyl groups had been taken from the methionine to make choline, presumably by methylating ethanolamine. It was found that this marked methyl group could be further transferred from the choline to creatine. The methyl group of the amino acid, methionine, could therefore be used by the body in synthesizing two of its essential non-amino acid constituents, choline and creatine.

The Continual Replacement of Amino Acids in Living Tissue Proteins. The extent to which nitrogen fed in the form of amino acids is synthesized into tissue proteins, both in the form of the fed amino acids and of other amino acids formed in the body from the fed material by transamination or other reactions, has been studied brilliantly by Schoenheimer[16] and his colleagues. They have synthesized amino acids with heavy nitrogen, N^{15}, have fed the amino acids to rats and mice, and have hydrolyzed the proteins in their bodies and isolated various amino acids from the hydrolysates. Finally, they have analyzed the isolated amino acids for N^{15} to determine the amounts of the ingested nitrogen that were built into the body proteins, both in the form of the administered amino acid and in the form of other amino acids derived from the administered one by transamination or other processes. They have found that incorporation into tissue proteins began almost immediately, and that, while more of the marked N^{15} was incorporated in the form of amino acid with which it was administered, than in any other amino acid, nevertheless a considerable proportion of the marked nitrogen was found distributed among other amino acids in the proteins.

The results of Schoenheimer and his colleagues have dispelled the view that the tissue proteins when once laid down remained as unchanging structural blocks until eventually destroyed by the wear and tear of metabolism. It appears that every protein molecule in the living body is itself alive in the sense that it is continually changing and renewing its structure.

Essential and Non-essential Amino Acids for Animal Nutrition. From the fact that by the transaminase action the body can synthesize some of its own amino acids, it would follow that not all the amino acids in the body proteins must be provided ready-made in the food proteins, but that some can be made in the body. The task of finding which of the 21 amino acids are indispensable parts of the diet, and which ones the animal body can build for itself, has occupied some of the leading biochemists since the time of Magnus-Levy's[17] demonstration that the rabbit could make glycine. The names of F. Gowland Hopkins in England and of Lafayette Mendel, T. B. Osborne and W. C. Rose in this country have been especially brilliant in the list of those who have unravelled this problem step by step. As the result of work by all the investigators in the field Rose[18] finally was able to divide the amino acids into the two groups listed in table 1, one which must be supplied in the food of growing rats, while the other group can be made by the rat and need not be supplied in the food. The list does not apply to all animals; for example, glycine is indispensable for the chicken. However, it appears probable, although not yet proven, that the necessities of man and the rat are the same or nearly so.

TABLE I

Essential amino acids must be supplied ready-made in the diet of rats	Non-essential amino acids need not be supplied in the diet of rats
Lysine	Glycine
Tryptophane	Alanine
Histidine	Serine
Phenylalanine	Norleucine
Leucine	Aspartic acid
Isoleucine	Glumatic acid
Threonine	Proline
Methionine	Hydroxyproline
Valine	Tyrosine
Arginine	Cystine
	Hydroxylysine

Detoxifying Effects of Amino Acids. It has long been known that various herbivora and man use glycine to combine with and detoxify benzoic acid by forming hippuric acid:

$$\underset{\text{Glycine}}{CH_2(NH_2) \cdot COOH} + \underset{\text{Benzoic acid}}{C_6H_5 \cdot COOH} = \underset{\text{Hippuric acid}}{CH_2(NH \cdot CO \cdot C_6H_5) \cdot COOH} + H_2O$$

The synthesis appears to occur in the liver, and the ability to form hippuric acid after glycine feeding is used as a test of liver function.[19]

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[15] V. du Vigneaud, M. Cohn, J. P. Chandler, J. H. Schenck and S. Simmonds, *Jour. Biol. Chem.*, 140: 625. 1941.

[16] R. Schoenheimer, *Physiol. Rev.*, 20: 218, 1940.

[17] A. Magnus-Levy, *Biochem. Z.*, 6: 523, 1907.

[18] W. C. Rose, SCIENCE, 86: 298, 1937.

In some much less obvious way cystine and methionine protect the liver from intoxication by chloroform. This peculiar effect of the two sulfur-containing amino acids was discovered by Miller, Ross and Whipple.[20] They had observed that a heavy feeding of meat would protect a dog from the effects of a dose of chloroform that would have led to fatal liver degeneration if administered in the fasting state. Investigation of the different types of amino acids yielded by protein digestion proved that only two containing sulfur had the protective effect.

Nutrition by Intravenously Injected Amino Acids. Henriques and Anderson[21] in Copenhagen demonstrated in 1913 that nitrogen equilibrium could be maintained with intravenously injected amino acids as the sole nitrogen intake. They placed a cannula in the neck vein of a goat kept in a stall, and maintained the animal in nitrogen equilibrium for several weeks by giving the necessary nitrogen in the form of a protein digest hydrolyzed completely to amino acids and injected in a slow stream through the cannula. The therapeutic application did not follow till 25 years later, when Elman[22] began the regular use of intravenous injections of predigested protein. Farr and MacFadyen[23] showed that the injected amino acids were assimilated fully as well as the nitrogen from proteins digested in the alimentary tract. A large part of the nitrogen required can be given in this form for a period of weeks. Whipple[24] and his colleagues and Elman[25] found that when the reserve tissue proteins of dogs had been depleted by fasting and the plasma proteins had also been depleted by bleeding, the proteins could be rapidly restored in tissues and plasma by administering a mixture of amino acids containing all those essential for nutrition, but not if essential amino acids were omitted. It appears that intravenous amino acid administration can be used to nourish the tissues at times when feeding by mouth is impossible or inadvisable.

Formation of Non-Protein Nitrogenous Constituents of the Body from the Amino Acids. Some of the amino acids in the tissues are condensed into peptides. Of these glutathione, which is glutamyl-cysteinyl-glycine,[26] is active in oxidation-reduction reactions. Carnosine, or beta-alanyl-histidine, occurs in mammalian muscle, and presumably has a physiological function. Another compound of beta-alanine is the vitamin, pantothenic acid.[27, 28] Serine combines with phosphoglycerides to form a constituent of nerve tissue.[29] Furthermore, animals have the power to transform the elements of amino acids in more profound ways than by condensation with their amino or carboxyl groups. Animals can be reared with no other nitrogenous foods than proteins and slight amounts of certain nitrogenous vitamins. Hence it appears that all the nitrogenous constituents that occur in large amounts in the animal organism can be formed from the amino acids yielded by the digestion of proteins. Among such constituents are the purines which form part of the nucleic acids of cell nuclei and the creatine of muscle tissue. The hormones thyroxine and adrenalin, from their organic structures, are presumably derived from tyrosine or phenyl alanine.

SUMMARY

We have followed the amino acids from their entrance into the alimentary tract in the form of food proteins through the successive steps of digestion, absorption into the blood stream and passage from the blood stream into the tissues, where they are concentrated by some unknown mechanism to many times their concentration in the blood plasma. We have seen something of the way in which certain of the amino acids can be transformed into one another in the body or synthesized from ammonia and keto acids. However, we have had to admit that our bodies can form in such ways only about half of the different amino acids that are required, and that the other half must be made for us by plants, bacteria or other organisms which have greater synthetic powers than we. And finally we have seen something of the manifold fates of the amino acids after they have entered our tissues; how they may be destroyed and their nitrogenous parts turned into urea in the liver before it is possible to put them to their more specialized uses, how their carbon fractions can be used to form glucose, how they may sacrifice themselves to protect us from toxic products, how they can serve as source material for certain vitamins, hormones and other compounds with physiological functions still to be identified, and how finally those amino acids which are not deflected to these various fates may enter into the proteins of the tissues and become for a time parts of our living structures.

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[19] A. J. Quick, *Arch. Int. Med.*, 57: 544, 1936.

[20] L. L. Miller, J. F. Ross and G. H. Whipple, *Am. Jour. Med. Sci.*, 200: 739, 1940.

[21] V. Henriques and A. C. Anderson, *Z. physiol. Chem.*, 88: 357, 1913.

[22] R. Elman, *Proc. Soc. Exp. Biol. Med.*, 36: 867, 1937; *Ann. Surg.*, 112: 594, 1940.

[23] L. E. Farr and D. A. MacFadyen, *Am. Jour. Dis. Child.*, 59: 782, 1940.

[24] S. C. Madden, W. A. Noehren, G. H. Waraich and G. J. Whipple, *Jour. Exp. Med.*, 69: 721, 1939.

[25] R. Elman, *Ann. Surg.*, 112: 594, 1940.

[26] F. G. Hopkins, *Biochem. Jour.*, 15: 287, 1921; *Jour. Biol. Chem.*, 84: 269, 1929.

[27] R. J. Williams and R. T. Major, SCIENCE, 91: 246, 1940.

[28] D. W. Woolley, SCIENCE, 91: 245, 1940.

[29] J. Folch and H. A. Schneider, *Jour. Biol. Chem.*, 137: 51, 1941; 139: 973, 1941.

SIBERIAN RESOURCES FOR SOVIET WARFARE[1]

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In this complicated world, there are many vital areas for the Allies, but few links in our strategy are more essential than the Soviet Union. Should it collapse, Germany and Japan would be joined and would have access to the wealth of northern Eurasia, with unpredictable consequences to America. German geopolitics has long looked eagerly to the Ukraine and the Caucasus, and the current Soviet victories will assuredly not be accepted by Hitler without challenge. The whole outcome of World War II may turn on the Soviet Union's ability to carry on.

This is a war of competitive production, so that access to raw materials is of vital importance. Geology may not be able to prophesy concerning military ability or morale, but it does have evidence on the material capacity of a country to produce basic war needs.

Two nations lead all others in mineral wealth, the United States and the Union of Soviet Socialist Republics. There is not even a good second unless federations such as the British Commonwealth are included.

It must be admitted that Soviet estimates are optimistic and often incapable of verification, but the general outline is now clear. Those unfamiliar with Soviet geological work in the inter-war period should remember that the Five Year Plans have laid great stress upon heavy industry and the underlying mineral production. Few sciences have received such consideration as geology, and as a result the known reserves have been enlarged several fold.

To sum up the military prospects, it appears probable that even though Germany should occupy all Soviet Europe, or even though Japan should seize Vladivostok; the Ural Mountains and central Siberia still have enough mineral wealth to maintain significant military production as long as the Second World War may last. The current prospects that Hitler's troops will overrun Soviet Europe appear poor, but even should that be the case, the Union still has the minerals, and the industrial capacity, to carry on. This applies not only to undeveloped reserves but to actual mines and smelters now in operation.

I shall review the various resources in a moment, but the situation is well in hand with respect to coal, iron, copper, lead, zinc and gold. Problems may arise concerning oil, aluminum and manganese, but there is a limited output of each within Siberia. In addition to Siberian reserves, there is still great productive capacity in unoccupied Soviet Europe. Large resources of oil, manganese, lead and zinc are available in the Caucasus, and Turkestan is also well supplied with minerals, but this paper is limited to Siberia.

The Soviet Union now credits itself with 1,654,361,000,000 metric tons of coal, second to the U.S.A. Ninety per cent. of this reserve lies in Siberia. So far as current *production* is concerned, three fifths comes from the Donetz field in the Ukraine, still largely in Russian hands, but there has been a great expansion in newer areas in Asia. This is notably true in the Kuznetz Basin of central Siberia, where the current production exceeds 20,000,000 tons, the equivalent of the output in Ohio. In this Kuznetz field the bituminous reserves are more than 450,000,000,000 tons, equal to our entire Appalachian field.

Within the Ural Mountains, coal is mined to the extent of 8,000,000 tons, chiefly at Kizel and Chelyabinsk, but none of it is of coking quality. Elsewhere in Siberia is the new Karaganda field, north of Lake Balkhash, with an output of over 4,000,000 tons; near Lake Baikal are the Cheremkhovo mines yielding 3,000,000 tons; other mines near Vladivostok produce nearly 3,000,000 tons; and a new field is developing at Bureya near the Amur River.

The annual yield of coal in Soviet Asia is 40,000,000 tons out of a national total of 146,800,000 (1940). While the total is but a third of American production, it is quadruple the tsarist output. Since the Kuznetz area is more than 2,000 miles from both German and Japanese frontiers, its operation appears reasonably dependable.

Petroleum production is no longer concentrated in Baku or even along the slopes of the Caucasus, although these still dominate. Northeast of the Caspian Sea is the important Emba district with salt dome structures. From the Urals westward to the Volga River is another new oil field, so promising that the Soviets term it a "second Baku." Siberia proper appears to be very poor in oil, but there is a significant production on the island of Sakhalin north of Japan. A pipe line runs from the Emba fields to Omsk in central Siberia. So long as Baku remains in Soviet hands, there will be no shortage, and the Caucasus Mountains present a formidable barrier to invasion.

Iron ore is wide-spread in the Urals, and forms the basis of imposing blast furnaces at Magnitogorsk, Sverdlovsk and Nizhni Tagil. These have a combined annual capacity of approximately 10,000,000 tons of pig iron, and open hearth furnaces turn out almost as much steel. The furnaces at Magnitogorsk are said to rank next to those of Gary in capacity. The ore is magnetite and secondary martite, formed by contact metamorphism, with a metallic content of 55 to 66 per cent.

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[1] Presented before the Geological Society of America, Boston, December 29, 1941.

Siberia's metallurgical problem does not concern any shortage of iron ore or of coking coal. The difficulty lies in the long rail haul required to bring them together. In the case of the Ural plants, coal is brought 1,417 miles from Kuznetz in central Siberia, while on the return trip the trains carry ore to blast furnaces near the coal. Steel plants thus operate at both ends of the combine. I have spent five days in the Kuznetz Basin, going through mines and blast furnaces, and found them up to the best American standards. Since the development of Kuznetz, nearby ore has been found which nearly meets the need of the local furnaces, while coal for the Urals has been developed at Karaganda, much closer to Magnitogorsk ore. There is a small iron output east of Lake Baikal, and a blast furnace has recently been built in the Far East at Komsomolsk on the lower Amur River.

In the Soviet Union as a whole, the principal steel production has been in the Ukraine, north of the Black Sea, based on Krivoi Rog ore and Donetz coal, but the Ural-Kuznetz combine has grown to the point where it now supplies one third of the nation's iron.

Manganese has been obtained from two major sources; the larger of the deposits is in the Ukraine, but the highest grade ore is in the Caucasus. The latter is still in Soviet hands. Within Siberia itself, there is a limited production of low-grade manganese in the Urals, in the Kazakh Republic and near Kuznetz. While inadequate, these Asiatic manganese deposits provide an emergency supply.

Reserves of copper have been greatly expanded under the Five Year Plans, but the quality of the ore is poor. There is a small production from pyrite-bearing ores and other types in the Ural Mountains, but the largest mines are north and west of Lake Balkhash. These are porphyritic deposits with about 1.1 per cent. copper. A new smelter at Kounrad has an annual capacity of 100,000 tons of metal, and even larger works are getting under way at Djezkazgan.

Lead and zinc reserves are estimated at 11 and 19 per cent. of the world totals, respectively. Soviet production is from the northern Caucasus, from the important Ridder mines in the Altai mountains and from scattered Siberian deposits. Lead production in 1936 amounted to 55,000 tons, while in the same year, zinc totaled 63,000 tons.

Aluminum was regarded as a deficit metal in tsarist Russia because the known bauxite deposits were limited and poor. Within recent years, the U. S. S. R. has built up a significant output, amounting to 60,000 tons in 1939, which lifted the nation to fourth place. Two deposits in the Urals supply a considerable part of the bauxite: Kabakovsk in the north and Kamensk in the south. Unfortunately the chief reduction plants are in those parts of Soviet Europe currently occupied by Germany.

Siberian mineral production also accounts for enough gold to place the Union next to South Africa in second place. This is secured partly from lode mines in the Urals but chiefly from placer works along the tributaries of the Lena River, notably the Aldan. Other Siberian localities are along the Kolyma and Yenisei Rivers. Modest amounts of nickel are mined in the Urals and Arctic. Within the Urals are large amounts of platinum, chromium, asbestos, potash and magnesite; while small amounts of tin and tungsten are produced east of Lake Baikal.

Soviet Europe has the enormous apatite deposits of the Kola Peninsula, the aluminum ores near Leningrad, the brown coal and hematite ores south of Moscow, and great steel centers in the Ukraine based upon local ore and coal. The Caucusus has oil and manganese. Many of these deposits are still in Soviet hands, but even their complete loss would by no means involve the cessation of defense production.

To turn from specific resources to mining areas, two major districts stand out, along with three lesser areas. By far the most valuable is the Urals, for there are few mountain ranges on earth which produce the variety or quantity of minerals secured here. Iron has been mined since the days of Peter the Great, and there are now 39 localities which produce iron or steel. The total reserves of Ural iron ore are placed at 1,390,607,000 tons. Great metallurgical plants provide the base for scores of industries, notably railway equipment, automobiles, tractors, heavy machinery and chemicals. Coal is mined in the Urals but is not of metallurgical quality. Oil is available on the western flanks and also to the south. Non-ferrous minerals include copper, gold, platinum, silver, nickel, aluminum, manganese, lead, zinc, chromium, asbestos, magnesite, potash and salt. All these place the Urals next to the Ukraine as the Union's number two metallurgical base. There are 8 industrial cities of over 100,000 people, led by Sverdlovsk.

The Altai-Sayan Mountains of south-central Siberia are a region whose mineral significance has scarcely been appreciated by non-Russians. Here is a third of the country's coal, lead and zinc, plus significant occurrences of iron ore, silver, gold, copper, tin and manganese. The coal basin of Kuznetz, southeast of Novosibirsk, dominates this second industrial base of Soviet Asia. The development of the Kuznetz steel works is one of the triumphs of the First Five Year Plan.

Third in significance is the Kazakh area, north of Lake Balkhash, where coal and copper have been developed in the inter-war years.

The fourth of Siberia's minerally-productive districts lies east and west of Lake Baikal, while the fifth is along the Amur River in the Far East. Reserves are considerable but production is only partly developed. Coal and iron are secured in a number of localities, and there is the beginning of a steel industry at Komsomolsk. Petroleum is obtained on the island of Sakhalin.

While Far Eastern developments are somewhat vulnerable to Japanese attack, production in the Urals and at Kuznetz seems secure from any feasible invasion, whether from east or west.

If mineral production will win the war, the Union of Soviet Socialist Republics has what it takes.

During the past two decades, the American public has been very reluctant to recognize the industrial potentialities of the Soviet Union. From the military record of recent months, it should be clear that any nation which can afford to lose tens of thousands of planes and tanks, and millions of soldiers, and still take the initiative, has far greater productive capacities than commonly appreciated. In the post-war world, it seems inescapable that the Soviet Union's geological foundations will place it in the first rank among industrial nations.

OBITUARY

GLOVER MORRILL ALLEN

SCHOLAR as well as student, an enthusiastic zoologist interested quite as much in the history and background of his subject as in the technical details, patient and persevering, with a most extraordinary fund of information and a capacity for methodical, detailed, accurate work possessed by few, taking keen pleasure in helping others though himself shy and retiring and always so far as possible keeping in the background, Dr. Glover Morrill Allen was one of the significantly outstanding mammalogists and ornithologists of his time. His published works are models of directness, clarity and accuracy. In reading them one instinctively feels his thorough mastery of the subject under discussion, and also one realizes that any statement made by him is authoritative and does not require checking. But his influence extended far beyond his published contributions. All his associates are more or less indebted to him for suggestions, advice or help of one kind or another, and some of them at times leaned rather heavily upon him. His unusual capacity for detailed work and his accuracy went far toward maintaining the high standard of the various publications he edited.

Glover Morrill Allen was born in Walpole, New Hampshire, on February 8, 1879, the son of the Reverend Nathaniel Glover Allen and Harriet Ann (Schouler) Allen, a sister of Rear Admiral John Schouler, U. S. Navy. At a very early age he became interested in mammals and birds. He prepared for college at the Newton High School, and while living at Newton in the winter and at Intervale, New Hampshire, in the summer he busied himself with an intensive study of the local faunas. Even when in high school he had an enviable local reputation as an authority on birds and mammals, although because of his shyness and diffidence he was personally known to very few. An unusually keen observer, he had already acquired a remarkably extensive knowledge of the details of the habits of the mammals and birds of his region, and his ability to recognize birds, particularly the numerous warblers, by their notes was almost uncanny. Like all the young zoologists of that region at the time, he made frequent visits to the natural history establishment of Charles J. Maynard, who always spoke of him as a most promising boy.

While living in Newton he made a large collection of the local mammals, all the skins being beautifully prepared and accompanied by full data. This collection, which included a porcupine, perhaps the last to be captured in Newton, was later presented to the Newton High School. In 1896 when a junior in high school he was elected an associate of the American Ornithologists' Union.

Entering Harvard, he was elected to the Phi Beta Kappa in his junior year, and received his A.B. *magna cum laude* in 1901. While at Harvard, in addition to the more usual courses, he applied himself to the study of Russian, and in the evenings studied Danish. He was awarded a John Harvard scholarship. In the year of his graduation from Harvard he was appointed secretary, and also librarian and editor, of the Boston Society of Natural History. Also in 1901 he published, together with Reginald Heber Howe, Jr., "The Birds of Massachusetts," in the preparation of which he had done the major part of the work.

In 1903 he received his A.M. degree, and in the same year published his book on the "Birds of New Hampshire." His Ph.D. he received in 1904; in June of that year he published a "List of the Mammalia of New England," and in July his doctor's thesis on "The Heredity of Coat Color in Mice." His interest in genetics was maintained throughout his career, and he was one of the few descriptive naturalists who was also versed in the experimental method and in the literature of contemporary biology, and was therefore enabled to apply the knowledge of one field in judging results in the other.

Always passionately fond of outdoor life and with an absorbing interest in the habits of birds and mammals, he had made many camping trips to various places, but especially to the White Mountains, an area he knew in minute detail. Now for the first time he had an opportunity to visit the tropics as a member of an expedition to the Bahamas.

In 1906 and 1907 he was a graduate student at Harvard, and in the latter year began working part time on the mammal collections of the Museum of Comparative Zoology. While he did most of the curatorial work of the department as well as carried on research it was not until 1924 when he retired as Secretary of the Boston Society of Natural History that he was appointed curator of mammals, a position which he held until his death. During 1906 and 1907 he was serving as editor of *The American Naturalist,* then published by Ginn and Company; this editorship came to an end when that journal was taken over by the Science Press in 1908. In the summer of 1906 he made a trip to Labrador with Dr. Charles Wendell Townsend, publishing a paper on the "Birds of Labrador," in cooperation with Dr. Townsend, in 1907. In 1909 he was a member of an expedition to British East Africa, and in 1910 he visited Grenada, British West Indies, making extensive collections in both regions. His monograph on *Solenodon paradoxus* appeared in 1910.

He was married on June 26, 1911, to Sarah Moody Cushing, who, with a daughter, Elizabeth Cushing (Mrs. Arthur Gilman), survives him.

He was a member of an expedition to the Sudan in 1912. In 1916 his monograph on the whalebone whales of New England was published. On the establishment of the American Society of Mammalogists in 1919 he became a charter member, and also a member of the board of directors, and in the same year he was elected president of the Nuttall Ornithological Club, succeeding William Brewster, a position he held until his death. He was elected a fellow of the American Ornithologists' Union in 1921.

He retired as secretary of the Boston Society of Natural History in 1924, and in the same year was appointed a lecturer in zoology at Harvard. His "Birds and their Attributes," a work remarkable for the vast amount of included information, was published in 1925. In 1926 he was a member of an expedition to the Belgian Congo and Liberia.

He was elected president of the American Society of Mammalogists in 1927, serving for two years. On his retirement as librarian of the Boston Society of Natural History in 1928 he was elected vice-president, a post he held for the remainder of his life. In 1928 he published, in cooperation with his old friend Gerrit S. Miller, "American Bats of the Genera *Myotis* and *Pizonyx.*"

He was a member of an expedition to Brazil in 1929, and in 1931 visited Australia.

The American Ornithologists' Union in 1937 selected him as editor of *The Auk,* and in 1938 he was appointed associate professor of zoology at Harvard. It was in 1938 that he published the first volume of his great monograph on the mammals of China and Mongolia, the second volume appearing in 1940. In 1939 he published a check list of the mammals of Africa, and also a most excellent popular work on bats, creatures which had always been of special interest to him and on which he was the leading authority.

This brief review of Dr. Allen's career gives but a very imperfect idea of his industry and accomplishments, and of the confidence that others felt in him. He published many papers on birds and mammals, most of them in Cambridge and Boston, and contributed many excellent and kindly reviews of the work of others, particularly to *The Auk.* In recognition of his achievements a number of birds and mammals collected by him, particularly in Africa, have been named for him by his friends.

Dr. Allen's interests were by no means confined to birds and mammals. He had an extensive acquaintance with many other groups, particularly with their representatives in New England. This was not surprising in the case of other vertebrates, which are not numerously represented in New England, but to see him recognize certain rare insects in the field was surprising. Once in a bog at Essex he suddenly exclaimed, "There is *Bombus borealis,*" and, sure enough, there was that rare little bumblebee flying about.

Personally, Dr. Allen was a man of the highest ethical type, one of that rare sort in whom you instinctively feel complete confidence. He was always courteous to every one, and always anxious to be of assistance in any way possible. He had a cheerful and equable disposition. He never became excited over anything, and if depressed he never showed it. Especially characteristic was a lively sense of humor. Frequently he would surprise one with a droll remark, or an unusual combination of words. For instance, a zoo to him was "a museum which is not yet dead." He was deeply religious, an Episcopalian, but this side of his nature he always kept strictly to himself. Always retiring and rather shy, he was particularly reticent about his personal affairs.

Dr. Allen's sudden death on February 14, 1942, came as a great shock to all who knew him, and to all those who knew and admired his work—a much larger group than he, modest as he always was, ever suspected.

AUSTIN H. CLARK

DEATHS AND MEMORIALS

DR. JOHN ALEXANDER MCGEOCH, professor of psychology and head of the department at the State University of Iowa, died on March 3, at the age of forty-four years.

PERCY TRAIN, fossil and plant collector, died on February 3. He was sixty-six years old.

THE death is announced of Dr. Cornelis Winkler, formerly professor of neuropsychiatry at Amsterdam, at the age of eighty-six years.

"A BOOK of Tributes to Charles Bernard Jordan," dean of the School of Pharmacy of Purdue University from 1924 until his death in April, 1941, has been issued by the university. It gives a reproduction of the illuminated parchment presented to him in honor of his twenty-five years of service to the university. Dr. Jordan joined the staff of the university in 1910.

THE Institución Cultural Española in Buenos Aires has established a laboratory for histopathologic research in memory of Professor S. Ramón y Cajal to be directed by Professor Pío del Río Hortega of Buenos Aires with a staff of eight investigators. The institute will promote investigations on the histology of the nervous system, employing the technic of Cajal and his school.

SCIENTIFIC EVENTS

GRANTS-IN-AID OF THE AMERICAN COLLEGE OF DENTISTS

THE American College of Dentists, through its Research Committee, offers annually a limited number of Grants-in-Aid and Research Fellowships. Information relative to such funds can be obtained by addressing the chairman of the Research Committee of the American College of Dentists, Dr. A. L. Midgley, 1108 Union Trust Building, Providence, R. I.

Research grants are made for one year only and are available on July 1. All applications should be made on blanks supplied for the purpose and must be in the office of the chairman of the committee by December 1. Action on requests for funds is taken once annually at a special meeting held by the Research Committee in February.

At a meeting held on February 21 in Chicago, the sum of $3,200 was allocated as follows:

$1,200 to Dr. Wallace Armstrong, of the University of Minnesota, for the continuation of an investigation of the effect of a fluorine free diet on the teeth of experimental rats and the determination of the fluorine content of some human diets.

$250 to Dr. Morris Steggerda, of the Carnegie Institution of Washington, Cold Spring Harbor, New York, for an investigation of the relation between growth and the eruption of the teeth in whites, Negroes and Indians.

$500 to Dr. Michael F. Bates, Tufts College Dental School, Boston, for an investigation to test the theory that the histological structure of the teeth is an index of the health of the individual during the period of tooth development.

$750 to Drs. H. R. Hunt and C. A. Hoppert, Michigan State College, for the continuation of an investigation of inheritance factors in rat dental caries.

$500 to Dr. James Nuckolls, of the University of California Dental School, for the continuation of a study of the primary centers of lobular development, growth and calcification of the tooth.

THE PROFESSIONAL STATUS OF CHEMISTS

THE professional status of chemists has been upheld by the National Labor Relations Board in a decision which lays down the principle that professional employees should not be forced into a bargaining unit composed of a miscellaneous group of skilled and unskilled workers as well as professional employees. It was held that only a majority vote of the professional group itself can determine its desires on the issue of union representation.

Describing the decision as "momentous," Dr. Charles L. Parsons, secretary of the American Chemical Society, says in a report to members of the society:

> While the board in earlier decisions had granted professional employees the right to express their choice in the matter of bargaining units, the unanimous decision rendered in the matter of the Shell Development Company and the International Federation of Architects, Engineers, Chemists and Technicians, Case No. R-3245, goes further than any prior decision of the board in establishing the right of professionals to self-expression within their group.

The controversy was submitted to the board on petition of the Federation of Architects, Engineers, Chemists and Technicians to set up a bargaining unit composed of both professional and non-professional employees. A group of professional employees of the company employed in professional work intervened, contending that professional and non-professional employees should not be merged into one unit.

When the case came to the board for hearing,

> the issue was squarely presented as to whether a union, by reason of having signed up a certain number of employees in a particular plant, could reach out and corral an almost equally large number of employees who had no desire to have that particular union represent them and

arbitrarily exclude from its proposed unit numerous other employees whom it had been unable to interest in its scheme because their inclusion in any voting unit undoubtedly would mean the loss of an election.

The board disposed of the union's contention by ordering two elections and designating two units for the purpose of the elections. The one unit is composed of all the skilled and unskilled employees in the plant. The other unit is composed of all the professional workers in the plant. Department heads and supervisory employees were excluded from the vote. In thus resolving the issue as it did the board afforded the professional employees an opportunity to express themselves in a group composed entirely of professional employees on the question of union representation for collective bargaining.

THE REMOVAL OF THE NATIONAL PARK SERVICE FROM WASHINGTON

By order of the Federal Budget Director issued on December 19, the National Park Service and two other bureaus of the Department of the Interior were directed to move their Washington offices to Chicago. The transfer of these and other federal agencies to make room for rapidly increasing defense workers has been opposed on various grounds.

Many of the agencies themselves have reported to the Congress that it would seriously disrupt their operations to move their main offices to distant locations. Appearing by request before a joint session of the Senate and House District Committees on January 9, Director Newton B. Drury testified that the National Park Service is already highly decentralized, with 5,263 employees in the field and (besides 533 with National Capital Parks) only 304 in Washington. He said that the service has many close relationships with other federal bureaus at the seat of government which are necessary for the efficient conduct of its affairs. He pointed out that the service has not only made many direct contributions to the defense program, but has suggested numerous alternatives to the War and Navy Departments for saving distinctive areas from uses that would cause irreparable damage. Fifty per cent. of the Washington office employees have indicated that they can not move to Chicago.

Congressional opponents of further decentralization gave up their fight to hold federal bureaus in Washington on January 14, when the Senate by a vote of 33 to 26 defeated a resolution calling for a report to the Congress on the government's removal plans. President Roosevelt has asserted that the transfer orders will not be revoked, but the Bureau of the Budget has already made some modifications of its original plans. Current studies are being made by the National Park Service to determine the possibility of further decentralizing its activities, so that the complete transfer of its Washington office to Chicago would be unnecessary.

If the National Park Service is moved away from Washington "for the duration," leaving only a small liaison unit to handle contacts with the Congress and other agencies, friends of the National Parks hope that under no circumstances will this move be made permanent, because the public interest would be ill-served by such an eventuality. During the absence of the service it will be more important than ever to have such a disinterested organization as the National Parks Association on the job in Washington, where it can remain alert to the recurring dangers of encroachment on the National Parks and related areas.

THE MEDICAL ADMINISTRATION CORPS OF THE ARMY

According to the *New York Times,* Colonel Leonard G. Roundtree, medical director of the Selective Service Board, in an address in Chicago at the annual meeting of the National Conference on Medical Service reported that "the Surgeon General of the Army has ruled that not only will the Army commission third- and fourth-year medical students as second lieutenants, but also first- and second-year medical students and pre-medical students of acceptable standing. They will be assigned to the Medical Administration Corps of the Army."

He explained that the students so commissioned would be in the Army Reserve and would not be called into active service until they had finished their education.

Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association, said that a similar program has been adopted in the Navy.

As reserve officers the students will be draft-proof. Heretofore, only the third- and fourth-year students and internes were accepted for commissions.

The ruling by Major General James Magee, Surgeon General of the Army, according to the *Times,* was in answer to warnings from members of the medical profession that a shortage of physicians would arise unless some uniform method of providing deferment for medical students was found.

About 12,000 pre-medical students apply for medical school entry each year, according to Dr. Fishbein, and about 6,500 are chosen. Dr. Fishbein said that the Army's ruling would apply only to those chosen and emphasized that at the first sign of a student's inability to handle the work he could be made eligible for the draft. He pointed out that this not only insures the Army and Navy of a plentiful supply of physicians, but will insure that civilian needs will not suffer.

APPOINTMENTS OF THE OFFICE OF CIVILIAN DEFENSE

The following appointments in the Office of Civilian Defense have been announced:

Dr. John S. Coulter, associate professor of physical therapy, Northwestern University Medical School, has been appointed Regional Medical Officer of the Sixth Civilian Defense Region, with headquarters in Chicago.

Dr. Dudley A. Reekie, assistant director of health and chief medical officer of the Tennessee Valley Authority, has been appointed Regional Medical Officer of the First Civilian Defense Region, with headquarters in Boston. He succeeds Dr. Allan M. Butler, Boston, who resigned to become head of the department of pediatrics at the Massachusetts General Hospital, Boston. Dr. Reekie entered on active duty on January 31.

Dr. Leonard A. Scheele, passed assistant surgeon, U. S. Public Health Service, Bethesda, Md., was recently assigned to the Washington staff of the Medical Division, Office of Civilian Defense. Dr. Scheele graduated from Wayne University College of Medicine, Detroit, 1933, and was commissioned in the public health service following the completion of his internship. Dr. Scheele was assigned in 1938 to the National Cancer Institute, Bethesda, as consultant on cancer control. There he conducted studies of the epidemiology of cancer, efficacy of cancer therapy, radiation protection and cost of cancer therapy.

Dr. Harold Marks, passed assistant surgeon (Reserve), U. S. Public Health Service, recently on the staff of the National Institute of Health, Bethesda, joined the Medical Division staff in January. Before being assigned to the Office of Civilian Defense, he was stationed at the National Institute of Health and was engaged in making surveys of medical care in defense communities.

William H. Carey, Jr., recently associated with the Norman Boosey Manufacturing Company, Detroit, has been appointed Regional Sanitary Engineer for the Sixth and Seventh Civilian Defense Regions, plus Indiana and Kentucky, with headquarters in Chicago, effective February 4. He has been commissioned Sanitary Engineer (Reserve) in the U. S. Public Health Service.

APPOINTMENT OF CAPTAIN N. H. HECK

REAR ADMIRAL L. O. COLBERT, director of the U. S. Coast and Geodetic Survey, announces that Captain N. H. Heck, formerly chief of the Division of Geomagnetism and Seismology of the Survey, has been appointed assistant to the director on scientific and technical matters. Captain Heck is well known in scientific circles as one of the world's leading authorities on earthquakes and the earth's magnetic forces.

Captain Heck entered the survey in 1904. He served at sea for a number of years and at various times commanded the survey ships *Hydrographer*, *Matchless* and *Explorer*. He had a large share in the development of the wire drag, which has been responsible for the discovery and charting, or ultimate elimination, of countless menaces to navigation. He also contributed materially to the early development of the Radio Acoustic Ranging method of hydrographic surveying.

His interest turning to research in magnetism he became, in 1921, chief of the Division of Terrestrial Magnetism. When the study of earthquakes was transferred from the Weather Bureau to the Coast and Geodetic Survey in 1926, his title was changed to chief of the Division of Terrestrial Magnetism and Seismology, in which capacity he served until he assumed his new work.

He is author of numerous books and articles on scientific and technical subjects. Among his works are: "Earthquakes," published in 1936; "Compensation of the Magnetic Compass," 1923; "Velocity of Sound in Sea Water," 1924; and "Earthquake History of the United States," 1928 and 1938. He has been the recipient of several honorary degrees and is a member of a number of scientific and engineering societies. From 1935 to 1938 he was chairman of the American Geophysical Union, and from 1936 to 1939 president of the Seismological Association of the International Geodetic and Geophysical Union. He is a past president of the Philosophical Society of Washington and of the District of Columbia Chapter of Sigma Xi.

SCIENTIFIC NOTES AND NEWS

THE William H. Nichols Medal of the New York Section of the American Chemical Society was presented to Dr. Duncan A. MacInnes, of the Rockefeller Institute for Medical Research, for "distinguished contributions to electrochemistry" at a dinner of the section in New York City on the evening of February 27. The presentation was made by Professor William C. MacTavish, head of the department of chemistry of New York University and chairman of the jury of award, which cited Dr. MacInnes for "outstanding investigations on electrolytes and the development of techniques which have immeasurably enriched both the theory and practice of modern electrochemistry." In his acceptance speech, Dr. MacInnes discussed "Galvanic Cells as Instruments of Research." Professor Herbert S. Harned, of Yale University, spoke on "The Work of the Medalist," and Professor George Scatchard, of the Massachusetts Institute of Technology, on "Dr. MacInnes—The Man." Professor Ralph H. Müller, of New York University, chairman of the section, presided.

THE 1941 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Forrest E. Ricketts, vice-president of the Consolidated Gas, Electric Light and Power Company, Baltimore, "for his contribution to the high reliability of power-supply systems, especially in the design of apparatus for selective relaying and circuit reclosure." The medal and certificate will be presented to him at the annual summer convention of the institute, which will be held in Chicago from June 22 to 26.

The award of the Wollaston Medal of the Geological Society of London to Dr. Reginald A. Daly was announced in Science last week. The following awards have also been made: The *Murchison Medal* to Professor H. H. Swinnerton, professor of geology at University College, Nottingham, for his "stimulating contributions to the philosophy of paleontology"; the *Lyell Medal* to W. S. Bisat, for "studies in the stratigraphical paleontology of Carboniferous rocks"; the *Wollaston Fund* to Dr. E. S. Hills, for "contributions to Australian paleontology and geology"; the *Murchison Fund* to Dr. K. C. Dunham, for "investigations into the mineral deposits of the North of England"; a moiety of the *Lyell Fund* to Dr. S. R. Nockolds, for "mineralogical and petrological work and his contributions to the study of assimilation processes"; a second moiety of the *Lyell Fund* to Dr. J. Shirley, for "researches in paleozoic paleontology and stratigraphy."

The William Mackenzie Medal of the University of Glasgow has been awarded to Dr. A. J. Ballantyne, formerly professor of ophthalmology, in recognition of his work in the ophthalmological branch of medicine and surgery. It is expected that Dr. Ballantyne will give in May the customary address before the section of ophthalmology of the Royal Society of Medicine.

Nature states that the Platinum Medal of the Institute of Metals for 1942 has been awarded to W. Murray Morrison, vice-chairman and managing director of the British Aluminium Company, "in recognition of his outstanding services to the non-ferrous metals industries."

The *Journal* of the American Medical Association reports that the New York Chapter of the National Gastroenterological Association held a special meeting on January 19 to mark the eightieth birthday of Dr. Max Einhorn, emeritus professor of medicine, New York Post-Graduate Medical School, Columbia University. The Rudolf Virchow Medical Society observed his birthday on January 5. He was given a testimonial dinner on January 10 by the staff of the Lenox Hill Hospital, with which he has been associated for more than fifty years.

Dr. S. A. Henry has been appointed by the Royal College of Physicians, London, to be Milroy lecturer for 1943. The subject of the lecture has been announced as "The Health of the Factory Worker in War Time."

According to *Nature,* the following officers of the Iron and Steel Institute have recently been elected: *President,* James Henderson; *Vice-president,* Dr. Andrew McCance; *Hon. Treasurer,* The Hon. R. G. Lyttelton; *Members of Council,* Professor J. H. Andrew and N. H. Rollason. Walter S. Tower, president of the American Iron and Steel Institute, has been nominated an honorary member of the institute, and the presidents of the Sheffield Society of Engineers and Metallurgists and of the Sheffield Metallurgical Association have been appointed honorary members of the council.

Dr. Everett Needham Case, Van Hornesville, N. Y., assistant dean of the Harvard Graduate School of Business Administration, has been elected the ninth president of Colgate University to succeed President George Barton Cutten, who is retiring after serving for twenty years. Mr. Case will take up his work at Colgate University on August 31.

Dr. W. W. Charters, since 1928 director of the Bureau of Educational Research of the Ohio State University, will retire from active work next August. He plans to devote his time to writing.

Dr. Lucius F. Badger, surgeon, U. S. Public Health Service, Washington, D. C., has become assistant director of the National Institute of Health, Bethesda, Md.

Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories of New York, has been elected a member of the board of directors of the American Bureau for Medical Aid to China.

Dr. George C. Dunham, director of the laboratories of the Army Medical School, Washington, and from 1931 to 1935 technical adviser to the Governor General of the Philippine Islands, has been appointed director of a new division of health and sanitation in the Bureau of Inter-American Affairs, of which Nelson A. Rockefeller is coordinator. Dr. Dunham will be placed at the head of a mission which is going to Ecuador to undertake malaria control, improvement of sewage disposal and other modern sanitation measures in cooperation with the Ecuadorean government. Members of the mission include Dr. Walter C. Earle, specialist on tropical medicine, of the International Health Division of the Rockefeller Foundation, and Wyman Stone, a sanitary engineer.

According to *Chemical and Engineering News,* Swift and Company, Chicago, has made a grant to be used under the direction of Dr. Ancel Keys, of the University of Minnesota, in a study of the relation of fatigue to diet. This work was originally sponsored by the National Research Council and is now operating under the Office of Scientific Research and Development in direct cooperation with the United

States Army Quartermaster Corps. Although much of this work is being directly applied to military and industrial needs during the present emergency, it will be possible to extend the findings to civilian nutrition.

An award of $1,000 has been made by the Borden Company to Irvington House, Irvington, to assist in its study and treatment of rheumatic fever. The researches are under the direction of Dr. Ann G. Kuttner, Irvington, resident medical director, with the guidance of a medical advisory board, of which Dr. John Murray Steele, New York, is director.

Dr. B. E. Dahlgren, chief curator of the department of botany of Field Museum, Chicago, is spending several weeks in various parts of Cuba, making a survey of the palms of that island, in order to obtain specimens of important species required to fill out the exhibits of palms at the museum.

Dr. L. T. DeVore, assistant professor of physics at Pennsylvania State College, has leave of absence to accept a call from the War Department for service as a radio engineer at the Aircraft Laboratory, Wright Field.

Dr. Albert R. Behnke, Lieutenant Commander, Medical Corps, U. S. Navy, instructor in charge of department of atmospheric hygiene, Navy Yard, will deliver the sixth Harvey Society Lecture of the current series at the New York Academy of Medicine on March 19. He will speak on "Physiologic Studies Pertaining to Aviation Medicine and Deep Sea Diving."

Dr. Joseph A. Pearce, director of the Dominion Astrophysical Observatory, Victoria, British Columbia, delivered an illustrated lecture entitled "The Rotation of the Galaxy," at the University of California at Los Angeles on March 2. The lecture was given under the auspices of the Department of Astronomy.

David Bruce Dill, director of the fatigue laboratory, Harvard University, and Dr. Arlie V. Bock, Henry K. Oliver professor of hygiene, will deliver the James M. Anders Lecture before the College of Physicians of Philadelphia on April 1.

The twenty-fifth annual meeting of the American Society of Ichthyologists and Herpetologists will be held in New York City from Tuesday, March 31, to Saturday, April 4. The business meeting and formal sessions will be at the American Museum of Natural History. Visits to the New York Zoological Park and to the Staten Island Zoological Park will be made. The annual banquet will be held at the American Museum of Natural History on Wednesday evening at 8 P.M. A joint smoker, with the American Society of Mammalogists, on the evening of Thursday is being sponsored by the New York Academy of Sciences. Two symposia are planned. The first, for mammalogists and ornithologists, on "Criteria for Vertebrate Subspecies, Species and Genera," will be formally conducted as a joint meeting with the American Society of Mammalogists. The subject of the second symposium for ichthyologists and herpetologists will be "Vertical Distributions."

The American Association of Industrial Physicians and Surgeons and the American Industrial Hygiene Association will meet in Cincinnati from April 13 to 17. The meeting will open with medical and surgical clinics at the Cincinnati General Hospital together with a conference on skin affections, the most common cause of occupational disease claims in industry. The second day's session will give attention to the health of industrial executives, including a consideration of heart disorders. The third day will be devoted largely to a symposium on lead poisoning. Subjects scheduled for the fourth day include Solvent-Vapor Poisoning, Ventilation of Deep Tunnel Operations and Safe Handling of Magnesium Castings. The final sessions on April 17 will cover proper prevention of tellurium fumes and other health threats, like lead chromate, encountered in metal industries.

A meeting, sponsored by the New York branch of the American Association of Scientific Workers, on "The Scientist's Role in Civilian Defense, War Research and Education" was held on March 11 at Columbia University. The meeting included discussion of a recent survey by the association to find the extent of participation in the war effort of scientific men. Representatives from the American Chemical Society, the Office of Scientific Research Development and other organizations attended and contributed to the discussions.

The Inter-American Chemists Congress, which was to be held at Santiago de Chile in January, 1942, probably will be held during the third week in September. The secretary of the organizing commission is Juan Hepp D., Casilla 3725, Santiago de Chile, from whom further information can be obtained.

Seven national library associations, working through their Joint Committee on Importations, have been engaged since October, 1939, on the problems involved in the importation of library materials in time of war. The committee has succeeded in completing negotiations which will make possible the importation during 1942 of a limited number of copies of scientific and technical periodicals and continuations from all countries of Europe, except Russia, Sweden, Switzerland, Spain and Portugal. Any responsible library may apply before March 30 for participation in the plan. Information may be obtained from the chairman of the committee, Thomas P. Fleming, medical librarian, College of Physicians and Surgeons, New York, N. Y.

Applications for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor Frederick G. Keyes, of the Massachusetts Institute of Technology, not later than April 15. Grants are made in aid of chemical research, generally for apparatus or supplies, or for the construction of special facilities needed for research in chemistry or in fields closely related to chemistry. Grants are not awarded for salaries, and on account of limited resources, the amount to an individual is seldom in excess of $300. Application blanks may be obtained from the chairman upon request.

The New York Hospital School of Nursing has become a part of Cornell University in an affiliation whereby qualified graduates will receive a university degree. Together with the New York Hospital and Cornell University Medical College, the School of Nursing is a unit in the medical center at 68th Street. It will be known as the "Cornell University-New York Hospital School of Nursing." The curriculum includes classroom study and practical experience in the New York Hospital. Students entering with two or more years of college work acceptable to Cornell University will be eligible for a degree of bachelor of science in nursing upon satisfactory completion of the three-year course.

Among the public bequests of the late Sir Arthur William Hill, director of the Royal Botanic Gardens at Kew, are £1,000 to Bentham-Moxon Trustees of the Royal Botanic Gardens; his diaries of various journeys are left to the library of the gardens; £500 to Kew Guild; £1,000 to the Royal Society; £500 to the endowment fund of St. Luke's, Kew Gardens, and, after personal bequests, of the residue, one eighth to King's College, Cambridge, and one eighth to Marlborough College. The value of the estate is placed at £93,379.

DISCUSSION

ON THE READING OF SCIENTIFIC PAPERS.

AUDIENCE ENEMIES NUMBERS I TO VI

A few years ago a large international congress was held in one of the most beautiful cities of Europe. The committee on arrangements had planned every detail to perfection. The university buildings were new, the lecture halls ample. Each platform was provided with a two-foot clock that not only pointed out the elapsed time but also turned on a red light at eight minutes and a big flashing light at ten minutes. When the meeting started, one could say "Every prospect pleases."

Only man was vile. One hour after the opening members realized that the distinguished chairmen of the sections were not holding the speakers to the ten-minute limit so carefully stipulated in the programs. Therefore, every speaker counted on talking fifteen or twenty minutes. Of course he saved his most important slides until the end and they were shown in competition with the flashing light plus an obviously nervous chairman.

In addition, there were all the other minor and major human defects best calculated to torture an audience. Most of the speakers mumbled their words or else turned and lectured to the lantern screen. This was particularly annoying, since the papers were delivered in four different languages, each with its local variants. Most of the lantern slides were photographs of typewritten sheets crowded with data, and few speakers were content to show less than twenty. The main points were carefully concealed until the last minutes, by which time the audience had lost all interest.

This meeting was perhaps an extreme example, and in our country most of the papers are carefully prepared and carefully delivered. There are, however, enough poorly delivered papers to warrant a discussion of what may be called "audience enemies":

1. The Mumbler, who drops his voice to emphasize important points or else talks to the lantern screen instead of to the audience.
2. The Slide Crowder, who packs his slides with typewritten data and shows too many slides.
3. The Time Ignorer, who talks beyond the limit specified in the program or justified by common courtesy.
4. The Sloppy Arranger, who jumbles his material.
5. The Lean Producer, who has poor material.
6. The Grasping Discussor, who when he gets talking stays talking.

Of course there are many other ways in which a speaker may cause discomfort, but the ones that I have selected are chosen because they can be remedied either by the head of the department or by strict self-examination.

Number 1, the Mumbler, is handicapped by poor habits of speech, an incorrectly placed voice or else an inherent nervousness. In other cases bad delivery is caused by lack of consideration in a man who is more interested in excreting words than in conveying information. When he turns to the screen and talks at the chart he is paying more attention to his own achievements than to the audience. This is particularly disastrous if he wanders away from the microphone.

Number 2, the Slide Crowder, wishes to show just as much of his data as possible and thus demonstrate his industry. He prepares many slides from typewritten sheets, because this is the easiest method. He ignores the fact that the typewriter has the worst possible type for display at a distance. Has any one ever seen such type used on advertising bill-boards? If he would only have his slides drawn with india ink the very labor involved would cause him to limit his material to the essentials, and these would be legible. It is a simple matter to calculate for a ten-minute paper just how many seconds each slide will be exposed on the screen and how much can be read and understood while thus exposed. Every nonessential word or figure distracts the eye from the small fraction that is essential. A good slide needs no pointer or verbal explanation.

The ideal method of competing with a slide is to employ one of the modern flashlights with a bright arrow that dances all over the screen and ceiling. There is nothing in black and white that has a chance of holding the eye when a bright arrow swoops and darts like a hornet.

Number 3, the Time Ignorer, who exceeds the limit set by the program is purely selfish or else overimpressed with the idea that his paper is much more important than the program committee had imagined. He may have planned deliberately to go overtime but more probably did not take the trouble to rehearse his paper with a watch. If he did use a watch he forgot that it always takes several minutes longer to deliver a paper from a platform than to read it in an empty room.

Number 4, the Sloppy Arranger, selects the method of presentation best calculated to confuse the audience. He may have in the back of his head the idea that he can lead up to a climax and hold the audience in breathless suspense until in the very last sentence he can prove that the venous blood of the wimpus contains only 3 milligrams of gadgetyl chloride instead of 4 milligrams. Would it not be kinder to the audience if he followed newspaper technic and gave in a headline, early in the talk, some idea as to what and wherefore?

Number 5, the Lean Producer, is only relatively lean. If he has one fact to exhibit and does it modestly he has made a contribution. If he does not recognize his paucity of material he does more harm than good. The real audience enemy is the man whose paper consists of trivia, errata, omissia, et cetera; mostly et cetera.

Number 6, the Grasping Discussor, can spoil almost any meeting. If he has been invited to open the discussion he has probably prepared a nice little paper of his own with scant reference to the paper of the evening. There is another type of discussor who happens to have in his pocket some lantern slides that he would just like to show for two minutes.

In the face of all these enemies the audience itself can do but little. The chairman, however, can do a great deal. Perhaps instead of chairman he should have the title of "Sole Protector of the Audience." If he has established a reputation for keeping people within their time limits they will take the trouble to arrange their material and lantern slides and bring out their main points in a decent manner. The faults of poor delivery, poor slides and poor material are the responsibility of the head of the department. He should guard the reputation of his institution. Unfortunately, some heads of departments exhibit in their own deliveries many of the faults enumerated.

The time to start training is when a man is young. In one medical school this has been tried successfully with the fourth-year students taking their clerkship in the medical dispensary. Every Saturday morning a group of clinical clerks have gathered to hear four fifteen-minute papers delivered by members of their class. The students have been warned that the papers are limited strictly to fifteen minutes and that in rehearsal they must not take more than twelve minutes. They are advised to talk to the men in the back of the room, since these are the most difficult to keep interested. They are taught that time spent in listening to a dull lecture, poorly delivered, is not wasted if they study the faults of the speaker and consider the methods by which they may be avoided. In a few sessions they develop a technic of delivery that is much better than the average found at scientific meetings. This allows the speakers and the audience to forget the delivery and concentrate on the subject-matter.

The man who goes overtime, uses crowded slides and mumbles his words is seldom more than 50 per cent. audience enemy. If his paper comes in the middle of the session it does not affect the first half of the program, even though he talks far beyond his limit. If his slides are crowded, half of the material can be read by the front half of the room. The same front half can usually hear him, even thought he mumbles his words. He would not dream of saying, "The public be damned." He just damns the rear half.

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CORNELL UNIVERSITY MEDICAL COLLEGE,
NEW YORK

ON A SYSTEM OF FILING REPRINTS

THE system of Professor McClung[1] for filing reprints seems to us rather interesting. We would like to suggest another one that is in use in the Division of Agronomy and Genetics at the University of Minnesota. This system originated with Professor H. K. Hayes. We found it extremely useful for our own work and for graduate students while teaching at the university during the fall quarter of 1941.

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[1] L. S. McClung, SCIENCE, 95: 122–123.

The system in use at Minnesota is very simple. Reprints are filed in reprint boxes that are large enough to take typed or mimeographed reports (8½″ × 11″). Each reprint is numbered (in consecutive order) and there is an index card for the subject-matter and also one for the author. These index cards are filed, one set for authors and another for subject-matter. As new reprints are received they are numbered and cross indexed on standard 3 × 5 library cards. Reprints are then filed in the boxes which are arranged on the shelves in numerical order. Since each box is full there is no trouble with reprints becoming doubled up as they do in partially filled boxes. There is never any problem of where to file reprints, and it is always easy to locate any reprint by subject or author.

We found this system much more practical than the system generally used where the reprints are filed alphabetically according to authors. Where graduate students are using the reprints it is important to have them well indexed both by subject and author.

Single unbound copies of several biological journals are also filed like reprints. Although there is a greater chance of losing some number of a journal the fact that the single issues are filed makes them available to a greater number of students at any one time. Any possible loss of single numbers is more than offset by the greater good derived by more students using the journals. Both reprints and single copies of the journals are signed out by students using them.

This way of handling reprints and journals seems to us very simple and practical. The important thing is that it works, and the reprints and journals are used extensively by the graduate students in the Division of Agronomy and Genetics.

W. Ralph Singleton

Connecticut Agricultural Experiment Station,
New Haven

THE STATUS OF EXPERIMENTAL PSYCHOLOGY AT THE UNIVERSITY OF MISSOURI

In a recent report on "The Status of Experimental Psychology among the Laboratory Sciences,"[1] the University of Missouri was included in a list of institutions which require laboratory science for the A.B. degree in the college of Arts and Science, but which do not accept experimental psychology in fulfilment of this requirement. In 1937, when the data for this report were obtained, this was true. In the academic year 1939–40, however, the Department of Psychology at the University of Missouri instituted a 5-semester-hour beginning course in general experimental psychology, which is now offered in addition to the usual 3-hour course in general psychology. Students may meet the biological science requirement for the A.B. degree in the College of Arts and Science by taking general botany, general experimental psychology or general zoology.

The catalogue describes the course in general experimental psychology as dealing with "the basic facts, principles, and methods of psychological science, with special reference to the human being," and as consisting of "lectures, classroom demonstrations, and laboratory experiments." There are three lectures and two 2-hour laboratory sessions each week. The course is taught from an experimental biological point of view with emphasis on experimental procedure and scientific attitude.

The course in general psychology, on the other hand, includes no laboratory work and emphasizes to a lesser degree the biological aspects of human behavior. It meets no specific requirements for graduation, but it may be substituted for general experimental psychology as satisfying the prerequisite for more advanced courses in the department.

Frederick A. Courts

University of Missouri

A NOTE ON "STOMATES"

Much as I sympathize with Dr. White's[1] protest against such unnecessary words as "stomates," it is only fair to point out that the word is not, as he seems to imply, etymologically badly formed. It is not comparable to "eggses." The Greek word is στοματ (stomat); the final consonant was dropped in the nominative singular for euphony, but appears in other cases, such as the genitive singular (stomatos). The Anglicization "stomate" is correct. Nor is the word really unwieldy; "stomates" is just as easy to say as "stomas."

Many of the more ludicrous efforts of biologists to bestow names upon their mental progeny betray the results of unfamiliarity with languages. It behooves us all the more to invoke some philological accuracy in criticizing them.

H. W. Rickett

The New York Botanical Garden

CEMENT AS A FIRE EXTINGUISHER

In the January twenty-third issue of Science there is a short article on the use of pitch as the best incendiary extinguisher, by Dr. R. Sayres, director of the U. S. Bureau of Mines.

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[1] J. E. Winter, Science, 95: 96–97, 1942.

[1] See Science, 95: 171, February 13, 1942.

It would seem to the writer that a good deal of caution must be used in the application of pitch to extinguish fire, even though it originates from a magnesium incendiary bomb. It has been the experience of the writer with a great variety of small fires in oil, metals and other materials, there is nothing so satisfactory and so foolproof as Portland cement as it is placed on the market. In many cases in the writer's experience it has been highly successful in extinguishing fires where water, carbon tetrachloride, foam and similar substances have been unsuccessful. This very common material so easily available and so safe to use should be placed at points where there is danger from fires either from incendiary bombs or from normal causes.

In our own laboratory, we provide such material easily available in kegs and find it far more successful than the usual fire extinguishers. Furthermore, it gives off no injurious gases and is in itself not combustible, as in the case of pitch.

ROY CROSS

KANSAS CITY TESTING LABORATORY

SCIENTIFIC BOOKS

CELESTIAL MECHANICS

The Analytical Foundations of Celestial Mechanics. By AUREL WINTNER. xii + 448 pages. Princeton University Press. 1941.

THE author states explicitly in the preface that the title of this volume is meant to imply that the general topological methods initiated by Poincaré are not discussed. For instance, virtually nothing is said of surfaces of section. Nevertheless, the author does find occasion to state (without proof) both the recurrence theorem of Poincaré and the ergodic theorem of Birkhoff, though not the mean ergodic theorem first proved by von Neumann. Also there are some well-chosen omissions from the purely analytical aspects of the subject: for example, the proofs of Bruns and Poincaré on the non-existence of integrals of certain types in the problem of three bodies. By making omissions of this kind the author has succeeded in isolating a well-rounded portion of celestial mechanics to which he has given an exceptionally thorough and scholarly treatment.

The first chapter opens with an explanation of the matrix and vector notation, which is used to advantage in many parts of the book for the sake of brevity, but which does not, in the opinion of the reviewer, add to the clarity of the exposition save in very exceptional cases: say, in the treatment of characteristic exponents in the following chapter. The first chapter, without actually mentioning the differential equations of Lagrange or Hamilton, introduces the idea of a "Lagrangian derivative" and gives an account of various mathematical formalities connected with the underlying group of canonical transformations. Certain special transformations are also treated: namely, rotations and the conformal transformations used later in connection with systems of two degrees of freedom.

In the second chapter are introduced the (conservative holonomic) dynamical equations with their Jacobi differential equations of variation. It is incidentally proved in this chapter (from the transversality conditions of the calculus of variations) that in a family of periodic solutions, in which the period is a function of class C' of the parameters, the period must be a single valued function of the energy alone. This interesting result, though well known and discovered independently by a number of mathematicians, has not previously (to the reviewer's knowledge) been published in any general treatise on dynamics. It is also in this chapter that mention is made of the ergodic theorem and that stability and characteristic exponents are discussed.

In the third chapter use is made for the first time of the hypothesis that the Lagrangian function is a quadratic polynomial in the velocities and that the purely quadratic part is positive definite. Various results are proved on the assumption that the coefficients of this polynomial are homogeneous of various degrees in the coordinates of the configuration space. Here also is presented the principle of least action and the closely related question of iso-energetic transformation. Systems with one and two degrees of freedom and systems with radial symmetry are considered in some detail.

In the fourth chapter we have a very extensive treatment of the problem of two bodies. Just because the derivation of the equations of planetary orbits from Newton's law of gravitation is a standard topic in elementary mechanics, we sometimes forget that the derivation of the coordinates as explicit functions of the time is by no means easy and indeed has been the subject of numerous classical investigations, leading, for instance, to the discovery of Bessel functions. Here the expansions connected with Kepler's equation are given an elaborate treatment. The problem is also considered with respect to a coordinate system rotating with uniform angular velocity about the center of gravity. This is a necessary preliminary to the systematic study of the restricted problem of three bodies.

The fifth chapter is largely an exposition of Sundman's work on the problem of n bodies (with special emphasis on the case $n = 3$). There is, of course, much about the Sundman theory which is intuitively evident.

Thus, in a motion in which r of the n bodies collide at $t=0$, one would expect the motion of the r colliding bodies to be relatively only slightly affected for numerically small values of t by the $n-r$ bodies which do not partake in the collision. Thus, for example, the theory of binary collisions is closely dominated by the theory of straight line motion of only two bodies, and Sundman's famous regularization of a binary collision is almost obvious. Even when the rigorous proofs are complicated (involving such things as Tauberian conditions), the theory is usually well motivated. A fundamental and deep result in this connection is to the effect that when all n bodies collide, the configuration ultimately becomes very close to a "central configuration." Hence a necessary preliminary for further progress (of certain kinds) in the n body problem is a detailed study of the central configurations and the closely related homographic solutions. Such a study is here given.

Also given in this chapter is a new explicit reduction of the problem of three bodies to a system of order 8, using the integrals of linear and angular momentum; or to a system of order 6, with use of the energy integral and elimination of the time. The coordinates used in the system of order 8 are, roughly speaking, the three mutual distances and the angle between the invariable plane and the plane of the three bodies. If there is no invariable plane, the motion takes place in a plane anyway, and it is this plane which is used instead of the invariable plane.

The last chapter is devoted to the restricted problem of three bodies with special reference to the limiting case considered by Hill in connection with the motion of the moon. Hill was able to compute numerically to a high degree of accuracy the coordinates of a one parameter family of periodic motions as functions of the time and period. The exact solution of this problem involves the solution of an infinite system of nonlinear equations, the appropriate existence theorems of which were first proved by Wintner some fifty years after the completion of Hill's calculations. This is probably the most important original contribution of the author, which is now published in a general treatise for the first time together with an account of Hill's original computations.

Other topics discussed in chapter VI are: regularization, the location and character of the critical points of the potential functions $\frac{1}{2}(x^2+y^2)+(1-\mu)[(x-\mu)^2+y^2]^{-\frac{1}{2}}+[(x-\mu+1)^2+y^2]^{-\frac{1}{2}}$ and $\frac{3}{2}x^2+(x^2+y^2)^{-\frac{1}{2}}$, and the non-planar restricted problem of three bodies. The book closes with a few general remarks about the divergent series of dynamics.

DANIEL C. LEWIS, JR.

UNIVERSITY OF NEW HAMPSHIRE

PHYSICS

Physics. By W. F. G. SWANN, D.Sc., director of the Bartol Research Foundation, the Franklin Institute of Pennsylvania; with the assistance of Ira M. Freeman, Ph.D., associate professor of physics, Central College, Chicago. New York: John Wiley and Sons, Inc.

THIS book is one of a series under the general title of THE SCIENCES, which in the words of the general editor, Professor Gerald Wendt, Ph.D., provides "a brief but significant survey of the fundamental sciences, an elementary but sound foundation for the further study, but above all a key to the understanding of our environment and of the possibilities inherent in science." The editor's choice of an author of the book on physics was a very happy one. Dr. Swann is eminently qualified for the task. His occupation as a director of research has freed him from the habit-forming routine of the classroom, and he has been able to write a book which is easy to read, full of information and devoid of pedantry. He ventures "to utter the heresy that the *ideas* are more important than the *facts*," and in his presentation of the subject he emphasizes the ideas. He gives no irrelevant facts and avoids mathematical formulas and argument.

After a brief introduction on the scope and purpose of physics, the book takes up the subject of Dynamics, treated by "a general discussion in which the methods of thought employed in this science are established," in which besides the conventional subjects of force and mechanical energy, we find a section on vibrations, an account of the relations of heat and energy and a sketch of the kinetic theory of matter and of thermodynamics. Then follow chapters on the main divisions of physics, presenting mechanics and heat again and going on in the usual order to the end. It may be noted as unusual in such presentations that we find an account of the development of the tempered scale of the piano, and a long—in proportion—description of lens optics. The story closes abruptly with electromagnetic induction. The concepts of the electron and the proton are used in the discussion of electrostatics and of electrodynamics as well, and it is hard to see why such important parts of physics as the electric discharge in rarefied gases and radioactivity have been omitted. I hope that the author is holding them back to serve as the introduction to another book in which he will present the new philosophy of physics which has grown up in recent years, in which "the revolutionary nature of the ideas involved is so great that our grandfathers would have required a lifetime to become accustomed to the implications of even a part of them." Dr. Swann would do this work admirably and when the book comes out he could appropriately name it "Metaphysics."

W. F. MAGIE

PRINCETON, N. J.

ANHYDROUS ALUMINUM CHLORIDE

Anhydrous Aluminum Chloride in Organic Chemistry. By CHARLES ALLEN THOMAS. In collaboration with Mary Baluk Moshier, Herbert E. Morris and Ross W. Moshier. American Chemical Society Monograph Series, No. 87. xiii + 972 pp. New York: Reinhold Publishing Corporation. 1941. $15.00.

AT last there is available a real encyclopedia of the manifold uses of anhydrous aluminum chloride in organic chemistry. Excellent monographs and review articles by Calloway, Groggins, Kränzlein, Montagne, Nenitzescu and others, have appeared within recent years, and have been most helpful, but nothing which has attempted to cover the field with the comprehensiveness and thoroughness of the present volume. Its author and his collaborators have rendered to all organic chemists a service which is sure to receive their grateful appreciation and sincere commendation. As the most complete and up-to-date handbook of the subject, it should be in the chemical library of every educational and research institution concerned with the field of organic chemistry, as well as of those corporations whose industries depend in any way upon the use of anhydrous aluminum chloride.

When "anhydrous aluminum chloride" is mentioned to an organic chemist, there rise instinctively and immediately before him the well-known and ubiquitous "Friedel-Crafts Reactions," and 378 pages of the volume are devoted to syntheses based upon such reactions. It is entirely fitting, therefore, that a portrait of Charles Friedel appears as the frontispiece, and one of James Mason Crafts upon page 76, and that a brief historical sketch (7 pp.) of these two distinguished chemists follows an excellent summarized and generalized introduction.

In addition to the pages occupied as noted above, separate chapters are devoted to the Physical Properties of aluminum chloride (45 pp.); the Mechanism of the Reactions Catalyzed by it (20 pp.); Addition Reactions (140 pp.); Aldehyde Syntheses; Aromatic Halogenation; Dehydrating Condensations (32 pp.); Dehydrogenation Condensations and Reduction Phenomena (20 pp.); Miscellaneous Condensations (20 pp.); Aromatic Rearrangements and Migrations (24 pp.); Effect of Aluminum Chloride on Aromatic Compounds (22 pp.); Aluminium Chloride in Aliphatic Chemistry (60 pp.); Polymerization (26 pp.); Aluminum Chloride in the Petroleum Industry (23 pp.); Preparation, Manufacture and Purification of Aluminum Chloride (24 pp.); and Notes on the Application of Aluminum Chloride (storage, transportation, particle size, etc.). In addition to complete author and subject indexes, there is an index of some 1,400 U. S. and foreign patents. References to the original literature appear throughout the text, the total number of such citations amounting to several thousand.

Paper, binding and presswork are up to the usual high standards of the publishers.

The two main purposes of the American Chemical Society Monograph Series are stated to be: (1) to present the knowledge available upon the chosen topic in a form intelligible to those whose activities may be along a wholly different line, to the end that other chemists may realize how closely their own investigations may be connected with other work which on the surface appears far afield; and (2) to promote research in the branch of science covered, by furnishing a well-digested survey of the progress already made, and by pointing out directions in which investigation needs to be extended. Both of these purposes are well served in this latest addition to the series.

MARSTON T. BOGERT

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SCIENCE TWENTY-FIVE YEARS AGO

BOTANY AS A NATIONAL ASSET[1]

IN connection with the organization of the National Research Council, I feel that American botany is offered a great opportunity of which we should take advantage. As a member of the council I wish to acquaint you with its purpose, so far as botany is concerned. Since the organization of the council was stimulated by the desire to develop a program of national preparedness, the natural first impression would be that, so far as botany is concerned, it is merely the problem of more efficient food production and distribution. This would stamp the enterprise at once as a problem of practical agriculture, in connection with which botanical investigators who are dealing with the fundamental problems of plants would have little or no part. Nothing is further from the intention of the council. The chairman has recently outlined the work of the council briefly as follows:

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[1] Concluding part of the presidential address before the Botanical Society of America, given in New York in December, 1916, and printed in the issue of SCIENCE for March 9, 1917.

1. To prepare a national census of research, showing what laboratories and investigators are available.
2. To encourage the cooperation of educational and research institutions in working out problems of pure science and industry.
3. To promote research in various branches of science in cooperation with leading national scientific societies.
4. To encourage scientific research in educational institutions. It is proposed, for instance, that in each advanced educational institution there be a committee on research to promote original investigations on the part of the faculty and graduate students.
5. To establish research fellowships in educational institutions, thus affording qualified workers an opportunity to devote themselves entirely to research work.
6. To secure wherever possible endowments for research purposes.

It is evident that so far from being primarily work in the practical application of what we know already, the enterprise is intended to be primarily a stimulus to fundamental research in every direction. It is not *practical application* that is to be stimulated chiefly, but *exploration,* which may or may not result in practical application. It is felt, for example, that the more we know about the structures and activities of plants, the better equipped we shall be to handle plants intelligently. Our botanical program, therefore, is simply to extend the boundaries of our knowledge of plants as far as possible. In pursuance of this program, at least two things are felt to be necessary.

In the first place, there must be developed some scheme of cooperation among our botanical establishments; and notably between the research establishments and the so-called practical establishments. For example, we recognize in general three great botanical agencies at work to-day, working independently, and in too great ignorance of each other's results. These agencies are the Department of Agriculture, the agricultural colleges and experiment stations, and the universities. All these agencies are investigating plants from various points of view, but they are not as mutually helpful or even as mutually stimulating as they should be in the interest of progress. I have met many cases of men intellectually equipped to work, but with no adequate material or equipment; and also even more cases of fine equipment and abundant material, and no man trained to use them effectively. In other words, the distribution of men and equipment is not as effective as it should be.

In the second place, there must be developed some plan of supporting research wherever there is a competent investigator. The movement to establish research fellowships has begun already, and as the value of research becomes better understood, there is no reason to doubt that every botanical explorer will have the opportunity to explore. There is at present a tremendous amount of waste in the investigators produced by the universities. Every year scores of young investigators, well equipped to continue exploration, are automatically side-tracked by a degree, and forced into positions where investigation is killed, or at least becomes anemic. The council proposes to conserve some of this investigative ability, and to give it a chance to express itself. In short, the opportunity now presented to us is to increase the opportunities for botanical research to such an extent by cooperation and conservation of investigative ability that the progress of botany should take on a greatly increased momentum. And all this can be done if at this psychological moment we as botanists can make it clear that a fundamental knowledge of plants is a great national asset.

THE LATE JOHN M. COULTER

REPORTS

THE AUSTRALIAN NATIONAL RESEARCH COUNCIL

IN October, 1940, the Australian National Research Council according to the *Australian Journal of Science* submitted proposals to the Prime Minister at his request, for a Scientific Advisory Committee on the lines of the Hankey Committee in Britain and the President's Scientific Advisory Committee in the United States of America. These proposals proved to be unacceptable, but an alternative arrangement was approved whereby the A.N.R.C. was to maintain close contact with the executive of the Council for Scientific and Industrial Research through a special representative. This arrangement was to be reviewed after twelve months.

As a result of the past year's experience the executive committee has made a request to the Commonwealth Government that it should authorize two men, selected for their knowledge of industry and science, to spend about three months examining the situation by consultation with leaders in industrial and other war activities. These two men would submit to the Prime Minister proposals for increasing the effective use of the country's scientific resources.

This proposal was first discussed fully with the Council for Scientific and Industrial Research, which has agreed to support the A.N.R.C. in this proposal.

The following is a brief review of some of the activities of the executive committee during the past twelve months.

Contact has been established between the Australian National Research Council and the following:

(i) The Executive of the Council for Scientific and Industrial Research.
(ii) The Adjutant General.
(iii) The Director General and Secretary of the Ministry of Munitions.
(iv) The Director General and Secretary of the Department of Supply and Development.
(v) The Chief Draughtsman, Maribyrnong.
(vi) The Controller of Materials, Ministry of Munitions.
(vii) The Assistant Controller of Industrial Chemicals.
(viii) The Chairman, Medical Equipment Control Committee.
(ix) The Department of Information.
(x) The N.S.W. Contracts Board.
(xi) The Army Medical Services.

The result of these contacts is that several scientific problems arising out of the nation's war effort have been dealt with by scientists in universities and elsewhere. The following are examples of this:

(*a*) A committee of chemists has, in cooperation with the Assistant-Controller of Industrial Chemicals, Ministry of Munitions, prepared a list of chemicals needed in Australia for industrial and analytical work and not manufactured here. The committee has initiated research work on some of these chemicals.

(*b*) The A.N.R.C. has initiated work on the preparation of fire-foam stabilizers (formerly imported) from peanut shells in Australia. This manufacture is about to begin on a scale large enough to supply all Australian requirements and, if required, to export abroad.

(*c*) The A.N.R.C. has initiated research work on the production of sensitizers, essential for engineering drawings, from chemicals available in Australia. In Maribyrnong alone over 2 million square feet *per annum* of this paper are used in munition manufacture, and it is all imported. Research to produce sensitizer has so far been successful, and at present the A.N.R.C., with the cooperation of the Ministry of Munitions, is about to conduct tests which will determine whether an Australian-made sensitizer can replace the imported material in munitions work.

(*d*) The Drug Sub-committee of the Association of Scientific Workers is affiliated to the Australian National Research Council and conducts its negotiations with the Medical Equipment Control Committee largely through the Australian National Research Council's representative. With the help of these negotiations several pieces of work of national importance have been done by the sub-committee.

(*e*) A sub-committee of the A.N.R.C. in collaboration with the Medical Equipment Control Committee has been examining the situation regarding the supplies of essential veterinary drugs.

(*f*) A sub-committee of the A.N.R.C. investigated the possibility of local agar manufacture, with the cooperation of C.S.I.R., and made recommendations concerning the importation of agar supplies for essential pathological and scientific work.

(*g*) A liaison officer has been appointed between Eastern Command and the Australian National Research Council to assist in the solution of scientific problems arising in the Army. The liaison officer, Major Pulling, is attached to the General Staff of Eastern Command.

(*h*) The A.N.R.C., with the agreement of the executive of C.S.I.R. and the vice-chancellors of Australian universities, will examine and comment upon the annual reports of the expenditure of the Commonwealth Research Grant to universities, and will publish summaries of the reports.

(*i*) Through its contact with the N.S.W. Contracts Board, the A.N.R.C. has been asked to give advice on technical difficulties in the fulfilment of war contracts.

(*j*) The A.N.R.C. has pressed for the appointment of entomologists to the A.I.F.

(*k*) The A.N.R.C. called a conference of representatives from the Australian universities and from C.S.I.R. to discuss the need for training workers in agricultural economics, in view of the need for collecting information before agricultural policy is determined.

SPECIAL ARTICLES

EQUILIBRIA IN AN ANTIGEN-ANTIBODY REACTION

According to a theory of immune precipitation developed elsewhere,[1] an equilibrium constant for the *initial reactions* between antigen (G) and antibody (A)

$$G + xA = GA_x$$

may be written

$$K_r{}^{*} = \frac{[\text{Satisfied valences}]}{[\text{free valences of G}]\ [\text{valences of free A}]}$$

$$= \frac{G_o x}{G_o(g - x)Ca}\ \text{mol}^{-1}\ \text{liters}$$

where "valence" is defined by the identity, G_o is the initial concentration of G, C is the equilibrium concentration of A, *g* is the maximal valence of G, and *a* is the maximal valence of A. This formulation requires three assumptions: that the initial reactions are bimolecular, that the strength of the forces binding a specified A molecule to G are not modified by the presence of other bound A molecules, and that the forces binding different A molecules are the same. The second assumption differentiates this equilibrium from that between H·, HCO_3^-, and CO_3^{--}, and the third distinguishes it from adsorption on heterogeneous surfaces.

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[1] A. D. Hershey, *Jour. Immunol.*, 42: 455, 1941.

* The constant k (= 1000/K_r) employed in (1) refers to the dissociation of the A-G complex, and to the unit volume 10^6 ml.

It was shown further[1] that precipitation occasions a minimal disturbance of the initial equilibrium when x = g–x = g/2, so that, approximately,

$$K_v = \frac{x}{Ca(g-x)} = \frac{1}{aC} \qquad [1]$$

after precipitation at this optimal ratio.

K_v does not refer to concentrations in the ordinary sense, but measures directly the strength of the valence forces, in terms permitting comparisons between different systems. This constant, if validly determined, is therefore of considerable immunologic significance.

It is the object of the present paper, however, to obtain the usual

$$K_c = \frac{[GA_x]}{[GA_{x-1}]\,[A]} \text{ mol}^{-1} \text{ liters} \qquad [2]$$

which has a different utility.

From data of Heidelberger and Kendall cited in reference 1, table 2, we estimated that the reaction of ovalbumin in rabbit antiserum 3.87II could be described by the parameters $a = 2$, $g = 5$, $K_v = 2.9 \times 10^5$. That is, at the point $x = 2.5$, $C = 1.7 \times 10^{-6}$ mols per l. We wish now to characterize, by means of K_c, the initial bimolecular reactions possible to this system (Table 1).

TABLE I

EQUILIBRIUM CONSTANTS AND FREE ENERGY DATA FOR AN OVALBUMIN-ANTIOVALBUMIN REACTION (DATA OF HEIDELBERGER AND KENDALL[a])

Reaction	K_v[*]	K_c	$-\Delta F^\circ = RT \ln K_c$
	$\times 10^5$	$\times 10^5$	cal.
$\frac{1}{x}G + A = \frac{1}{x}GAx$ ..	2.9	...	7000†
$G + A = GA$	"	20	8300
$GA + A = GA_2$ ...	"	12	7800
$GA_2 + A = GA_3$ ...	"	5.8	7400
$GA_3 + A = GA_4$ ...	"	2.9	7000
$GA_4 + A = GA_5$ ...	"	1.2	6500

Standard state: Aqueous solutions of the order 10^{-5} M in serum diluted 1:5 with 0.15 M NaCl.

Temperature: 0 C.

[a] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 62: 697, 1935.

[*] The constancy of K_v for the successive reactions is in part an assumption (see A. D. Hershey, *Jour. Immunol.*, 1941, on which the validity of the computed K_c's depends.

† RT ln K_v, *i.e.*, the decrease of free energy associated with formation of the G–A bond. The remaining values have the usual significance.

It is evident from the assumptions made above that, for the mean value $x = 2.5$, the mol fractions of the various GA_x's participating in the initial equilibrium may be obtained from the successive terms of the expansion $(p + q)^n$ where $n = 5$, $pn = 2.5$, $p = 0.5$ and $q = 1 - p$. Accordingly,

mol fraction G = 0.03125
" " GA = 0.15625
" " GA_2 = 0.31250
" " GA_3 = 0.31250
" " GA_4 = 0.15625
" " GA_5 = 0.03125

from which since $[A] = 1.7 \times 10^{-6}$, the values of K_c for the successive reactions may be obtained by [2].

This method is alternative to another, which is less obvious but considerably more convenient when *g* and *n* are large. Thus for the single reactions

$$GA_{x-1} + A = GA_x$$

$$K_v = \frac{x[GA_x]}{(g-x+1)\,[GA_{x-1}]\,2[A]} = \frac{x}{2(g-x+1)} K_c \qquad [3]$$

The K_c's computed by [3] are identical with those given by [2].

In Table 1 these values are listed for the successive reactions, together with $\Delta F^\circ = -RT \ln K$ referred to the arbitrary standard state represented by dilute solutions of the reactants in serum diluted with 0.15 M NaCl.

The striking feature of the ovalbumin-antiovalbumin reaction is the very large value of the equilibrium constants, which could scarcely be determined at all except for the large molecular size of antibody. This is, however, in keeping with the well-known "irreversible" character of the A–G reaction.

It should be noted that the equilibrium constants of the successive reactions decrease very markedly as *x* increases, which accounts for the partial recovery of antibody by dissociation from precipitates formed in the region of A excess[2,3,4] and failure in other regions.[3,4,5] This result, as here interpreted, does not imply "a graduated variability in the firmness of union"[2] of successive A molecules, a conception rather generally accepted at present.[6,7] On the other hand, this possibility can not be excluded by ignoring it, as is done by the assumptions made in the present theory. Experimentally, one observes only a minor variation of K_v computed for different points in the reaction range, and this has been attributed to the secondary effects of precipitation.[1] The significant fact is that the results achieved appear to justify the simpler assumptions. It remains to be seen within what quantitative limits this is true.

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[2] F. M. Huntoon, *Jour. Immunol.*, 6: 117, 1921.

[3] M. Heidelberger and E. A. Kabat, *Jour. Exp. Med.*, 67: 181, 1938.

[4] A. D. Hershey, G. Kalmanson and J. Bronfenbrenner. Unpublished.

[5] P. H. DeKruif and J. H. Northrop, *Jour. Gen. Physiol.*, 5: 139, 1922–23.

[6] J. R. Marrack, "The Chemistry of Antigens and Antibodies." Great Britain Medical Research Council, Special Report Series No. 230, 1938.

[7] Szu C. Liu and H. Wu, *Chinese Jour. Physiol.*, 16: 97, 1941.

The question of the reversal by dissociation of the *biologic effects* of immune reactions may be somewhat clarified in view of the variations of K_c for the successive reactions. Thus, other parameters being the same, a system in which the "neutralization" of a molecule of antigen brought about by reaction with considerably less than g molecules of A might appear irreversible, whereas in a system in which neutralization requires many ($\sim g$) molecules of A, reactivation should be readily demonstrable. In practice, success depends on whether the necessary degree of dilution, and the necessary lapse of time, are experimentally feasible.

The free energy data offered are, of course, subject to those errors,[1] of unknown magnitude at present, affecting the measurement of K_v. The values appear to be reasonable. In fact, Boyd *et al.*[8] recently assumed that $\Delta F^\circ = -10^4$ cal. for a similar reaction "which goes very nearly to completion but may be reversed experimentally."

We are now studying the phage-antiphage equilibrium,[4] which is in some respects more amenable to measurement, with the expectation of obtaining a more complete thermodynamic description of this typical immune reaction.

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EFFECT OF INSULIN ON PYRUVIC ACID FORMATION IN DEPANCREATIZED DOGS[1]

PREVIOUS work on man has revealed an increase in pyruvic acid in the blood following the ingestion of glucose.[2] In diabetic subjects no increase in blood pyruvic acid occurred under the same conditions. The administration of insulin together with glucose to these patients resulted in an increase in blood pyruvate.[3] In order to study the relationship between insulin and pyruvic acid formation 27 experiments have been performed on 14 depancreatized dogs. The animals were maintained with insulin and pancreatin until 72 hours before each observation. The method for estimating pyruvic acid was modified to eliminate interference by the 2, 4 dinitro-phenylhydrazone of acetoacetic acid.[4, 2]

Experiments on normal animals disclosed a significant rise in blood pyruvate over the fasting value after the intravenous injection of 2 gm of glucose per kg body weight. In depancreatized dogs there was no rise in blood pyruvate after a similar injection of glucose. When insulin was administered simultaneously with the glucose a marked rise in pyruvate occurred (see table I representing a typical experiment) reaching its maximum from one to three hours after the injection. If a second injection of glucose was made four hours after the administration of insulin a second rise in pyruvic acid took place. When the blood sugar level was raised to 750 to 950 mg per cent. for 3 to 5 hours by a continuous infusion of a 5 per cent. glucose solution, (300 ml per hour) after a preliminary injection of 2 gm glucose per kg, an elevation of blood pyruvate occurred despite the absence of insulin. The blood pyruvate under these conditions reached a constant level within one or two hours. The injection of insulin after three hours of glucose infusion produced a further rise in blood pyruvate.

TABLE I

BLOOD PYRUVIC ACID AND BLOOD SUGAR AFTER THE INTRAVENOUS INJECTION OF GLUCOSE (2 GM PER KG) INTO A DEPANCREATIZED DOG (BOTH EXPERIMENTS WERE PERFORMED ON THE SAME ANIMAL)

Time	No insulin		40 units insulin	
	Blood pyruvic acid mg per cent.	Blood sugar mg per cent.	Blood pyruvic acid mg per cent	Blood sugar mg per cent.
Before injection	1.28	380	1.14	337
10 min. after "	1.23	775	1.35	725
20 " " "	1.28	662	...	...
30 " " "	1.29	572	2.52	445
45 " " "	1.28	515	...	...
60 " " "	1.19	478	3.46	270
90 " " "	1.22	438	...	...
120 " " "	...	...	3.12	243

In agreement with previous observations[5] the rate of removal of intravenously injected pyruvic acid (1 gm per kg as sodium pyruvate) from the blood was the same in normal and depancreatized dogs.

It may be concluded from these experiments that, in the depancreatized dog, insulin increases the formation of pyruvic acid after the administration of glucose.

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[8] W. C. Boyd, J. B. Conn, D. C. Gregg, G. B. Kistiakowsky and R. M. Roberts, *Jour. Biol. Chem.*, 139: 787, 1941

[1] Aided by grants from the John and Mary R. Markle Foundation and the Williams-Waterman Fund of the Research Corporation.

[2] E. Bueding, M. H. Stein and H. Wortis, *Jour. Biol. Chem.*, 140: 697, 1941.

[3] E. Bueding, H. Wortis and H. Fein. Unpublished observations.

[4] D. Klein, *Jour. Biol. Chem.*, 137: 311, 1941.

[5] E. Flock, J. L. Bollman and F. C. Mann, *Jour. Biol. Chem.*, 125: 49, 1938.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SENSITIVE HUMIDISTAT

THE unreliability and low sensitivity experienced with a commercial hair humidistat led to the development of a control operated by the differential in temperature between ether-filled wet and dry bulbs. The difference in vapor pressures of ethyl ether contained in the bulbs (see diagram) due to the temperature difference displaces a mercury column across the platinum contacts sealed in the connecting tubing.

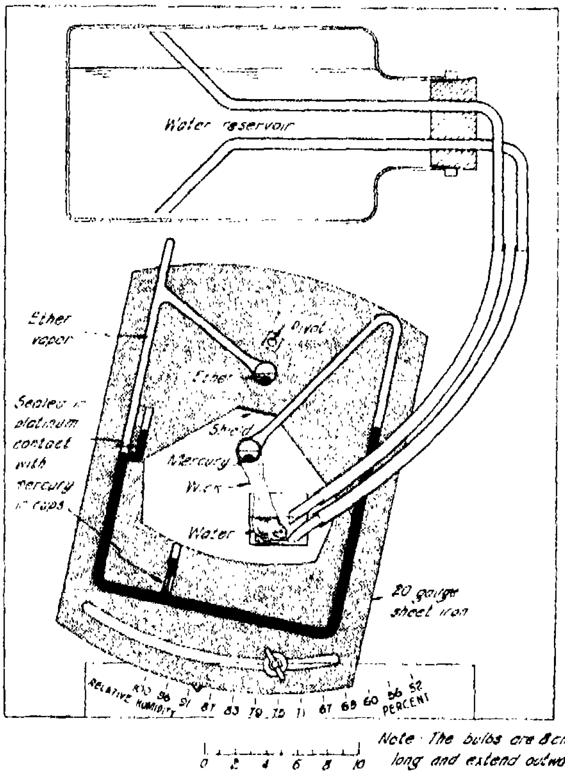
Approximate adjustment for the desired humidity range is obtained by varying the amount of mercury in the manometer tube by adding or subtracting from a reserve supply stored in the bulbs. Final adjustment is made by swinging the instrument about a pivot. The 13 cm distance apart of the manometer legs facilitates the changing of the mercury level with respect to the upper platinum contact. With the instrument illustrated, a removable paper scale serves for approximate testing, but final adjustment must be made by trial and error for precise values, since the wet-dry bulb differential as well as the ether vapor pressure difference depends to a degree upon the environmental temperature.

The large reservoir serves to supply the wick cup with distilled water over an extended period of time. The constant-level device utilized is indicated in the diagram.

The practical sensitivity of the control depends to a large extent upon the rate of change of humidity in the environment and air flow over the bulbs. Sling psychrometer readings indicate, however, that in a closed constant-temperature room, control has been obtained well within 1 per cent. relative humidity of a desired value. In the original design, the instrument was adjusted so that one end of the mercury column moved along only a slight upward incline. Such an arrangement gives approximately twice as much movement of the mercury column for a given pressure differential as the normal arrangement. Further increase in sensitivity might be obtained by utilizing the principle of the sloping manometer.

The vertical manometer tube must be sufficiently long so that the lowest humidity will not cause displacement of the mercury into the wet bulb and necessitate readjustment. In the instrument illustrated the 21 cm is sufficient for stability down to approximately 32 per cent. relative humidity at 25° C. If the instrument is to operate at low humidities, it would be essential to extend the tubes for a distance of about 35 cm above the level of the top platinum contact. Calculations of the height required are easily made for a given set of conditions by reference to data upon vapor pressure of ether[1] and to psychometric tables.[2]

No difficulties have been encountered due to the inflammable nature of ether. The instrument was filled with dry ether after addition of sufficient mercury. The outlet was sealed off after slowly boiling away the excess ether under reduced pressure, leaving only enough ether to slightly less than half fill both bulbs, which are about 8 cm long and extend outward sloping slightly downward. (Not clearly illustrated in the sketch.) The sealing off is carried out with the ether still boiling so that any residual air would be insufficient to cause an explosion or to exert a partial pressure which would interfere with the operation of the instrument. While the relatively nonexplosive chloroform might be utilized, the vapor pressure change at room temperature is only about one third that of ether. The reduced sensitivity would probably not be of importance for many applications but would be advantageous in order to reduce the tube length required at low humidities.


Water reservoir
Ether vapor
Pivot
Ether
Sealed in platinum contact with mercury in cups
Shield
Mercury
Wick
Water
20 gauge sheet iron
RELATIVE HUMIDITY 100 96 91 87 83 79 75 71 67 63 60 56 52 PERCENT
0 2 4 6 8 10
Scale in centimeters

Note · The bulbs are 8 cm long and extend outward with a slight downward slope

FIG. 1

---

[1] International Critical Tables.

[2] *U. S. Dept. Agr. Weather Bureau Bul.* 235. 1937.

A sensitive relay is required, as otherwise the heating at the mercury-platinum contact is sufficient to cause trouble in the operation of the instrument; however, either a 2 ma 110 V. AC or a 10 ma 6 V. DC relay has been found satisfactory. The relay should be normally closed for the instrument as illustrated if used in a humidifying system.

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SECTIONING AND STAINING REFRACTORY MATERIALS IN PARAFFIN

Many tissues, as, for example, the lens of the vertebrate eye, are difficult or impossible to section in paraffin with ordinary methods. Such materials may be cut in celloidin, but the celloidin method has several disadvantages, chief of which are (1) the impracticality of cutting thin sections and (2) the difficulty of keeping serial sections in order.

None of the steps in the paraffin method to be described here are new—in fact, all are to be found in the tenth edition of Lee's "Microtomist's Vade-Mecum"—but they have been combined in an unusual way and the results obtained have been more than satisfactory.

The steps in the method, as it was finally developed, are as follows:

(1) Fix material in Bouin's solution;

(2) Transfer, without washing, to 100 per cent. dioxan and change once during an eight-hour period;

(3) Transfer to paraffin containing 0.5 per cent. beeswax and change twice during an eight-hour period;

(4) Embed in the usual manner and then expose tissue by cutting away one side of the block;

(5) Soak block in water for at least twenty-four hours before sectioning;

(6) Section;

(7) Place section (or sections) on water on clean slide and warm gently;

(8) Allow to cool and replace water with solution No. 1 of Mallory's triple connective tissue stain. Stain for five minutes;

(9) Drain off first stain and replace with Mallory's solution No. 2. Stain for five minutes;

(10) Drain off second stain and replace with water;

(11) Drain off water immediately and replace with 95 per cent. alcohol;

(12) Drain and repeat with absolute alcohol;

(13) Center section on slide and run over it a few drops of 0.5 per cent. celloidin (dissolved in equal parts of ether and alcohol);

(14) Dry for several hours or overnight;

(15) Clear in xylol;

(16) Mount in balsam or clarite.

The materials used in testing the method consisted of the following: frog heads (adult *Acris gryllus* and recently metamorphosed *Rana pipiens*); skin from frog (*Rana pipiens*); skin from seven-day old rat; grasshopper eggs (*Melanoplus differentialis*); amphibian eggs in early cleavage stages (*Triturus* sp.); compound eyes from grasshopper (*Melanoplus differentialis*); compound eyes from beetle (*Dytiscus* sp.); human lens with cataract; and pathological human liver tissue.

All were sectioned at 4 and 6 micra with unbelievable ease except the *Dytiscus* eyes which could not be cut successfully at less than 8 micra. On the other hand, frog's skin and frog's head, including the lenses of the eyes, were sectioned at 2 micra.

Cellular details were found to be even better than those obtained with ordinary paraffin methods. Such structures as intercellular bridges, rods and cones of the retina, the cytoplasm of the cells in the lacunae of cartilage, ciliated epithelium of the oral cavity, muscle striations and the cells surrounding the lens in the sections of the frog's head were in excellent cytological condition. Mallory's stain, when used as described above, shows greater delicacy and precision than is obtained when sections are stained after the removal of the paraffin. Another advantage of the method lies in the fact that tissues such as vertebrate lens and insect cuticle remain flat and do not curl away from the slide as they almost invariably do when sections containing them are spread and dried in the usual way.

The method outlined above is rapid, simple, gives perfect, thin, serial sections of materials ordinarily very difficult to cut and insures fine cellular detail.

The authors are indebted to Dr. James H. Allen, of the Department of Ophthalmology, Medical School of the State University of Iowa, and to Drs. R. L. King, L. O. Nolf and T. L. Jahn, of the Department of Zoology, for supplying the tissues.

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Armbruster, David A. *Competitive Swimming and Diving.* Pp. 301. Mosby. $3.25.

Dukes, H. H. *The Physiology of Domestic Animals.* Fifth edition. Pp. xiv + 721. Cornell University Press.

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ELIHU THOMSON[1]

1853–1937

By Dr. KARL T. COMPTON

PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FOR one destined to apply his genius largely toward harnessing electricity for the work and comfort of man, the decade beginning with 1850 was a timely period in which to be born. The preceding half century had witnessed the fundamental discoveries which underlie the utilization of electricity, and imaginative minds had begun to direct these discoveries into the broad channels of practical and commercial employment.

In the development of the electrical art this first half of the nineteenth century was a remarkable fifty years, and because it provided the foundation for the practical achievements which came in the second half, a review of it helps to give perspective to this memoir on Elihu Thomson.

The century opened auspiciously with Volta's discovery of the voltaic cell, and with the demonstration by Nicholson and Carlisle of electrolysis. In 1820 Oersted announced his discovery that an electric current has the power to deflect a magnetic needle. In this same year Ampere brilliantly elucidated Oersted's discovery by giving mathematical expression to the forces produced by electric currents. Six years later Ohm announced the formulation of his law that current is proportional to the electromotive force, and twenty years later Gauss and Weber invented an acceptable system of electrical and magnetic units.

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[1] Condensed from a memoir presented to the National Academy of Sciences.

Meanwhile, Faraday had begun the epochal researches which were to lay the foundations of electrical engineering. In 1821 he had succeeded in making a wire revolve about a magnet and a magnet about a wire, and ten years later, almost simultaneously with Henry in America, he made the great discovery underlying almost all electrical machinery—electromagnetic induction. This led him to the mechanical production of a steady electric current by revolving a copper disc between the poles of a magnet.

Minds with a practical bent were quick to follow the road which Faraday and Henry had pointed out. By 1850, the electric motor had been demonstrated, the commutator had been devised, the electric arc had been experimentally used for lighting, and efforts had been made to drive boats, buggies and locomotives by electricity. But the conquest of electric power was still thwarted by practical difficulties; only in the form of the telegraph and a few other devices had electricity been put to work effectively.

It was during this stage in the development of the electrical arc that Elihu Thomson was born in 1853, and it was not until he had embarked upon his professional career at the tender age of 17 and was ready to join the creative thrust that the drive toward economic utilization of electric power had really begun to gain ground rapidly. In 1875, five years after Gramme had built his ring-wound armature, and along with Siemens had made the dynamo a practical machine, Thomson had built a dynamo and by 1879 he had invented and patented a three-coil arc dynamo—a pioneer three-phase generator. He thus early took prominent place in the brilliant group, including Brush, Edison, Siemens, Stanley, Tesla, Van Depoele, Weston and others, which was to solve the problem of generating adequate current. The electrical tide was approaching its flood and Thomson was ready—with consequences important to the development of the electrical industry.

The young man who thus auspiciously began his career in Philadelphia was born in Manchester, England, on March 29, 1853, of a Scotch father, Daniel. and an English mother, Mary Rhodes. Elihu was the second son of the family, which ultimately was to total eleven children, six boys and five girls. Four years after Elihu's birth, the panic of 1857 struck England and his parents, moved by the resulting scarcity of work, decided to emigrate to America, which they did in 1858, settling in Philadelphia.

In February, 1866, Elihu was admitted to the Central High School in that city, even though he lacked several weeks of having attained the required age. Four years later he was graduated as fourth honor man and accepted employment in a commercial laboratory where analyses were made of iron ore and other minerals. He remained in this post for about six months and then returned to Central High School in the fall as "Adjunct to the Department of Chemistry" at a salary of $500 per year.[2]

One of the senior professors whom he assisted in this post was Edwin J. Houston, who held the chair of physical geography and natural philosophy, and the two were soon engaged in collaborative investigations which led to a long partnership. The first publication growing out of their research was a paper "On a New Connection for the Induction Coil," contributed by Professor Houston to the June, 1871, issue of the *Journal of the Franklin Institute*. The paper contained an account of Thomson's observations of sparks drawn from grounded waterpipes during the operation of a nearby induction coil. Although he did not recognize the significance of the evidence at the time, he had clearly observed the propagation of electrical waves through space. When, in 1875, Edison announced a new "etheric" force which he described as non-electrical, Professor Thomson was primed to dispute his conclusions, for he wrote later:

> I had proposed to Houston that we carry on these experiments and show definitely that the so-called ''etheric'' force that Edison had announced in the papers was merely an electrical phenomenon. At this time I took upon myself the enlargement of the scale of the experiments, so as actually to obtain a very definite result. This was carried out, as follows, in 1875. A 6-inch spark Ruhmkorff coil was set up with one terminal connected by a wire about 5 feet long to a large tin vessel mounted on a glass jar on the lecture table. When the coil was in operation, sparks were allowed to jump across the terminals of the coil itself, these sparks being about 1½ inches to 2 inches long and having the character of condenser sparks. When the coil was in action, I explored the whole building throughout the several floors and then went up to the top of the building to the observatory, where Professor Snyder had charge of the astronomical instruments. It was found that tiny sparks could be obtained from metal objects wherever they were, in the cases or outside, from the door-knobs or from apparatus, by the simple expedient of shading from the light and detecting the tiny sparks with a pointed pencil by applying it, say, to the door-knob. I recognized clearly that this was a manifestation of electric waves passed through space, and I also understood that a system of communication might readily be based thereon.[3]

A description of this experiment was communicated to the Franklin Institute by Professor Houston and printed in its *Journal* for January, 1876. With the exception of Joseph Henry's experiments, which were unpublished, here was one of the first experimental demonstrations of the validity of Maxwell's theory, and here, too, was an example of Professor Thomson's extraordinary intuition anticipating the wireless transmission of signals over a decade before Hertz demonstrated electromagnetic waves and twenty odd years before Marconi received his patent on "telegraphy without wires."

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[2] ''The Philadelphia Period in the Life of Professor Elihu Thomson,'' by John Louis Haney. *The Barnwell Bulletin* of Central High School, February, 1939.

[3] Unpublished notes of Professor Thomson in the files of J. A. McManus, General Electric Company, Lynn, Mass.

Again in Thomson's nineteenth year, the *Journal of the Franklin Institute,* August, 1871, carried an account, written jointly by Thomson and Houston of further original work. This paper, "On the Change of Color Produced in Certain Chemical Compounds by Heat," was a pioneer discussion of this phenomenon. His next important paper, "On the Inhalation of Nitrous Oxide, Hydrogen, and other Gases and Gaseous Mixtures" appeared in the *Philadelphia Medical Times,* November 15, 1873, and foreshadowed his later work on the use of helium in diving and caisson work.

By 1877 Thomson was swinging into his full stride. He had received the master of arts degree from his institution and had been appointed professor of chemistry and mechanics. His capacity to work productively in a variety of fields had been amply demonstrated by creative work in both chemistry and physics. He had, during a series of successful lectures at the Franklin Institute, anticipated the system of electric-welding he was later to patent, he had conceived the idea of a cream separator, and he had described the operation of tuning one electrical circuit to another.

Thomson regarded his "more serious interest in electrical applications"[4] as beginning in 1878 with a series of tests on dynamos then in commercial use. This report had been preceded in the *Journal of the Franklin Institute* by papers on the relaying of the telephone and on "A New System of Electric Lighting and a New Form of Electric Lamp," and it was followed in 1879 by "Circumstances Influencing the Efficiency of Dynamo Electric Machines" published jointly with Professor Houston in the *Proceedings* of the American Philosophical Society. This paper, as did the report to the Franklin Institute, emphasized the advantage of low internal resistance in a dynamo as compared to the resistance of the external circuit.

It was in 1879 that he and Houston built a dynamo with three-phase winding. This machine, patented in 1880 and now at the Smithsonian Institution, was known as the "bakery machine" because of its use for lighting a large bakery in Philadelphia. "This is the machine," Thomson once noted, "upon which the Thomson-Houston Electric Company was based. . . . I think this is a very important invention, inasmuch as the great power generators of to-day are three-phase dynamo machines with three-phase armature winding. . . ."[5]

Having made fundamental improvements in the dynamo, Thomson and Houston, prompted by the commercial application of arc lighting by Brush, rapidly rounded out a complete and reliable arc-lighting system. They devised a constant current regulator (1881), an air blast method to extinguish or prevent the arc tending to occur when an electric circuit is opened (1882), and the magnetic blow-out (1883), which employs a magnetic field to extinguish an arc.

Of this arc-lighting development Dr. Dugald C. Jackson, the well-known electrical engineer, has said:

> Arc lighting has largely been superseded by later forms of electrical illumination, but I am personally inclined to put forward this invention of the automatically regulated dynamo for arc-lighting service as one of Thomson's most important, on account of its influence on his own work and the development of his opportunities. The invention was made when he was still in his twenties. It was carried through substantially on his own responsibility except for meager financial aid, and drew out at this early age, at least in some degree, those qualities of originality, courage, resourcefulness, far-sighted thinking and powers of experiment which were so notably the foundation for his distinguished and productive career.[6]

For similar reasons I have dwelt in detail on Professor Thomson's Philadelphia days, particularly on his work at Central High School. By the time he resigned from the school in 1880, he had unmistakably demonstrated his wide-ranging genius, and in his work there are to be found the seeds of his later achievements. Here it was, too, that he developed his lifelong interest in education and that fondness for teaching which led him throughout his life to cherish the title "Professor" above all others.

Professor Thomson resigned from Central High School to become "electrician" for the American Electric Company, a firm organized early in 1880 at New Britain, Conn., to control the Thomson-Houston patents. Two years later Thomson, at the suggestion of Charles A. Coffin of Lynn, Mass., formed the Thomson-Houston Company to take over the assets of the New Britain Company, and in 1883 the business was moved to Lynn. With Coffin assuming the burden of finance and management, Thomson was free to give undivided attention to research and technical development, and for the first time he was able to surround himself with competent assistants. The result of this happy arrangement was one of the most extraordinary records of technical achievement in the history of the electrical industry.

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[4] "Pioneer Investigations on Dynamo Machines Fifty Years Ago," by Elihu Thomson. The *Journal of the Franklin Institute,* July, 1928.

[5] Unpublished notes of Professor Thomson in the files of J. A. McManus, General Electric Company, Lynn, Mass.

[6] Address of Dugald C. Jackson at the meeting in commemoration of the life and work of Elihu Thomson, February 16, 1939. In the files of the American Philosophical Society, Philadelphia.

Founded in the period when Edison was demonstrating the commercial possibilities of electricity with his "Jumbo" dynamos, the company grew rapidly. In 1884 it employed 184 workers, but by 1892, when it was merged with its competitor, the Edison General Electric Company of Schenectady, the number had grown to 4,000.[7] The result of the merger was the General Electric Company, with Coffin as president and Rice, who had been manager of the Lynn plant, as vice-president and technical director. Not the least of Professor Thomson's contributions to the success of this great industrial organization was his demonstration of the value of industrial research.

Returning to the record of Professor Thomson's inventions, we find him in 1885 applying his magnetic blowout to lightning arresters. This fundamental method of breaking electric currents became the foundation for automatic circuit breakers and for controllers of electric cars and trains.

The basic idea of his lightning arrester derived from a knowledge and study of scientific phenomena involved in the discharge of electricity through gases. A transmission line, of course, has to be insulated from the earth by insulators adequate to prevent spark-over at the voltages used. If, however, the line is struck by lightning or an abnormally large electric surge passes through it, a spark may pass around the insulation, and it is a peculiarity of sparks through air that when once the insulation of the air is broken down by a spark there is no inherent limit to the amount of current which can flow. Thus these sparks frequently cause serious short circuits.

Professor Thomson's discovery consisted in placing the insulator between the poles of a magnet, with the result that the spark or arc which might be produced was acted on by electrical forces in such a way as to elongate it in the form of a bow which became more and more extended until it finally became so long that it went out.

Again in these early days and long before the importance of it was understood, Thomson had outlined the now universally used method of transmitting alternating current by transformers. He had written out a description of the system in 1878 and set up a working model at the Franklin Institute in 1879, but his patent application was not filed until 1885. After an unusually strenuous history in the Patent Office because of interferences with the work of Gaulard, Gibbs, Brush and others, the patent did not issue until 1902. When it did issue it covered every alternating current distribution system in the country, and it is not surprising, therefore, that the courts subsequently held the patent invalid.

In the further development of alternating current machinery he devised constant current transformers embodying the magnetic leakage shunt (1889), and a movable secondary (1894), which could be adjusted, in relation to a fixed primary, to give constant current output. Again, in the direction of increasing the power capacity of transformers, he obtained patents in 1890 covering the cooling of transformers by oil immersion and by air.

One of Professor Thomson's most fundamental discoveries was the principle of dynamical repulsion between a primary and secondary coil. This can be demonstrated by a variety of interesting lecture experiments, most of which were suggested and shown first by Professor Thomson himself. One of these experiments still serves as a spectacular demonstration for popular science lectures and for elementary classes in physics. A vertical wire coil is surrounded by a spool of wire through which a large current can be passed upon throwing a switch. A metal ring which slips easily over this core is dropped around it from above. Immediately upon closing the circuit this ring is shot up into the air by the repulsive action of the electric current produced in the ring and the primary current in the coil. This scientific observation was developed by Professor Thomson into an alternating current repulsion motor which is nothing more nor less than our present repulsion induction motor.

In the field of electrical measuring instruments, he invented the "inclined-coil" instrument (1895) and the Thomson integrating wattmeter (1889). It is this latter meter which is now almost universally used for measuring amounts of electric power used. In 1890 this instrument was exhibited in Paris and a prize of 10,000 francs for meters was divided between Thomson and Aron.

He next turned to the investigation of high-frequency phenomena. Already he had conceived the notion (1876), as I have mentioned, of tuning electric circuits, an operation fundamental to modern communication systems, and he had observed the propagation of electrical waves through space. In 1890 he patented a dynamo operating at frequencies 30 to 40 times greater than any previous machine. This led him to design high-frequency transformers. While working in this field he discovered (1893) a method of producing still higher frequency alternating current from a direct current arc, by shunting the arc with inductance and capacity, thus discovering the method which played such an important rôle in wireless transmission up until its virtual replacement by electronic tube devices. This interesting method of producing alternating currents was independently developed and applied to wireless telegraphy by Poulsen, and is therefore generally known as the Poulsen arc.

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[7] "Professor Thomson and the Development of the Lynn Electrical Industry," by J. A. McManus, Tercentenary edition "Greater Lynn," June, 1929, Lynn Chamber of Commerce.

Among his many other electrical inventions should be noted his resistance electric furnace patented in 1894, and a dynamo-static machine (1900) by which it was possible to obtain high-frequency discharges suitable for vacuum-tube apparatus.

In the summer of 1858, when 5 years of age, Thomson had seen Donati's comet and in 1867 he witnessed spectacular meteor showers. These early observations prompted his abiding interest in astronomy. In later years he published nearly a score of papers on astronomical subjects ranging from discussions of zodiacal light to solar eclipses.

Still other scientific byways of Professor Thomson's interest were the earth sciences. He published on "The Nature and Origin of Volcanic Heat," and in his last appearance before the American Academy of Arts and Sciences in 1933, he read a paper on "The Krakatau Outbreak." The eruption of this volcano in Java occurred when he was a small boy in Philadelphia, and had incited the curiosity which he always exhibited. He had watched for evidences, in the brilliant sunsets, of the volcanic ash in the upper atmosphere and had, I am informed, recorded his observations. At a much later date he hired as a research assistant a survivor of the catastrophe and induced him to record his personal observations of the event.

With all this intensive activity, Professor Thomson lived a rich family life. He was married on May 1, 1884, to Mary L., daughter of Charles Peck of New Britain, Conn., and of this union there were four sons, Stuart, Roland D., Malcolm and Donald T. In 1916 Mrs. Thomson died, and on January 4, 1923, he was married to Clarissa, daughter of Theodore F. Hovey of Boston.

Behind all his astonishingly varied interests, stood a man who had complete faith in the efficacy of the scientific method, and who in all his activities, vocational and avocational, was a shining exemplar of the scientific spirit. Observation and experimental inquiry were his chief reliances; he apparently did not resort to the mathematical or analytical methods that most scientists and engineers use who tackle problems as complex as he solved. He was not, like Steinmetz, a gifted mathematician; he seemingly did not need to employ mathematical analysis because his teeming mind leapt to correct conclusions without it.

His powers of observation he carried into every walk of life, and no one could be with him for ten minutes without being impressed and stimulated by his perception and by his wide-ranging knowledge of natural phenomena. He could best be described by saying that he was a brilliant natural philosopher who was held in equally high esteem by practical engineers and by academic scientists.

I have spoken of his devotion to education. His long association with the Massachusetts Institute of Technology affords a specific example. He became a lecturer in electrical engineering at this institution in 1894, and from then until his death he maintained with it the closest sort of relationship. He was elected a life member of the corporation in 1898, was acting president from 1920 to 1923, and for many years was a member of the executive committee of the corporation. He likewise served Harvard University as a lecturer and as a member of several of its visiting committees.

In other ways he never ceased to teach. His friend, Dr. Richard C. Maclaurin, President of the Massachusetts Institute of Technology from 1909 to 1920, observed:

> Throughout his life he has not only done great things himself but shown an intense desire to help all who are struggling earnestly with scientific problems. He has proved an inspiration to an ever-widening circle of engineers and others who have intrusted him with their secrets and sought his help in overcoming their difficulties. They have done this, knowing that they had only to ask in order to get the full benefit of his imagination and his power, and that they need have no misgivings that he would take any advantage of their confidence or any credit for their work, for he has no touch of selfishness.

From my own association with him I can validate Dr. Maclaurin's tribute. He combined in a most remarkable way the constructive power of the inventor, the intuition and imagination of the great scientist and the kindly balance of the ideal philosopher, teacher and friend. His life encompassed the development of the electrical industry, and he will long be remembered as one of those who brilliantly extended and applied the primary discoveries of Faraday and the other pioneers in the science of electricity.

He died on March 13, 1937, in his eighty-fourth year.

GROUP ORGANIZATION AMONG VERTEBRATES[1]

By Professor **W. C. ALLEE**
THE UNIVERSITY OF CHICAGO

IN our laboratory and elsewhere, so far as we have found by gleaning through the literature, most students of group organization in animals have been attracted to the subject primarily by the opportunity to study general and comparative sociology.

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[1] A shortened version of an illustrated lecture on this subject which was given as a part of the symposium on "Integration of Biological and Social Systems" at the recent Fiftieth Anniversary Celebration of the Univer-

We have not been attempting an oblique attack upon group organizations of men; but while this is true, all of us who have worked with these problems have found our attention and curiosity caught by certain similarities between group organization in animals and some of the simpler phases of human society. Perhaps it will be such comparisons that will most interest the reader. I think it is wise for them to be made, providing that due restraint is exercised. In order to understand the integrations of human society we need to know how much is uniquely human and how much is, on the other hand, the specialized human development of a more generalized primate pattern, which derives from mammalian and lower vertebrate patterns which in turn are related to certain types of invertebrate social organization.

To be more specific, the social integrations of mice and hens, cattle, fish, frogs, lizards and turtles and many other animals have much in common with the organization of certain human groups. Without taking the comparisons too seriously, and leaving primary sex relations entirely aside, these similarities may help explain human social organizations; I would not say that the human social variant is justified either because it resembles or departs from the more generalized type.

The modern period in the study of social organization of groups of animals in which the individuals were in some way distinguished from each other was initiated by Schjelderup-Ebbe,[2] twenty years ago. A large descriptive literature has accumulated in this field and there has been a promising beginning of analytical work. Most of these studies have dealt with loosely caged flocks of various species of birds and the social order of the common domestic fowl has attracted particular attention. Reports of somewhat similar group organizations in nature are also beginning to appear.[3]

At Chicago we have been interested in these phenomena as one phase of the broad field of animal aggregations. We have studied the organization pattern in several different species of birds and in certain mammals, especially mice. The following discussion will be based mainly on the work at our own laboratory; not because it is most important, but because of our familiarity not alone with the results obtained but also with the observational and experimental errors and personal biases which may affect conclusions.

One of the most regular social hierarchies which we have observed is summarized in Table 1.

TABLE 1

THE SOCIAL ORDER IN A FLOCK OF WHITE LEGHORN HENS

Individual	Number pecked	Individuals pecked							
BB	8	RG	RR	GG	BR	YY	BY	GY	RW
RW	7	RG	RR	GG	BR	YY	BY	GY	—
GY	6	RG	RR	GG	BR	YY	BY	—	—
BY	5	RG	RR	GG	BR	YY	—	—	—
YY	4	RG	RR	GG	BR	—	—	—	—
BR	3	RG	RR	GG	—	—	—	—	—
GG	2	RG	RR	—	—	—	—	—	—
RR	1	RG	—	—	—	—	—	—	—
RG	0	—	—	—	—	—	—	—	—

Such a social order among birds is based on what has come to be called peck-right. The higher ranking individuals are able to peck those of lower rank without themselves being pecked in return. This right is usually won at the first or at least during one of the early pair contacts between each two adult members of the flock either as a result of an active fight or by passive submission of one of the members of the contact pair.

Often the flock is not so simply and regularly organized. One of the most frequent irregularities comes when a low-ranking hen has the peck-right over some individual that outranks her in general social position. Another fairly common complication occurs when triangle situations arise in which *a* pecks *b*, *b* pecks *c* and *c* pecks *a*, and then all have the peck-right over those lower in the social scale. There is not space here to suggest all such variations or to discuss what is known about their causation.

The organization in a flock of hens represents a type of social pattern in which dominance, once won, is relatively permanent. At least one other type of social structure also exists among birds. With pigeons, doves, canaries and shell parrakeets, for example, although the flock organization is no less real, the outcome of any given pair contact is less predictable. Such flocks are organized on what may be called peck-dominance rather than on the more absolute peck-right relations that exist among hens and certain other birds. As was discovered several years ago[4] and confirmed more than once,[5, 6] the peck-dominance type of social order is related in part to territoriality in that certain birds are dominant in one territory and subservient in another.

All group organizations among birds are apparently based on the ability of birds to recognize and remember their flockmates as individuals. When territory enters as a factor, recognition of the indi-

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sity of Chicago. A more nearly complete account will be published, together with the other papers in that symposium, in a forthcoming volume of "Biological Symposia."

[2] *Zeitschr. f. Psychol.*, 88: 225–252, 1922.

[3] E. P. Odum, *Auk*, 58: 322–323, 1941.

[4] R. H. Masure and W. C. Allee, *Auk*, 51: 306–325, 1934.

[5] H. H. Shoemaker, *Auk*, 56: 381–406, 1939.

[6] E. Diebschlag, *Zeitschr. f. Tierpsychol.*, 4: 173–188, 1941.

vidual's territory also becomes a part of the group reactions system. Shoemaker[5] has shown that the space available for a flock of canaries is a matter of importance. When they are confined in a relatively small space, the social order becomes relatively simple and definite; it is little complicated by territoriality. Given more space, individual territories tend to become established in which the territory holder is usually supreme, even though it ranks low when in the neutral ground about bath bowls, feeding trays and in the other areas of the canary public service system. Even a socially low-ranking male normally dominates other males in some restricted space about his nest.

In connection with the intermingling of territoriality and social dominance, there are available many unpublished observations made locally by Mr. Dale Jenkins and Mrs. Barbara Hale Brainerd which show that a family of blue geese, as a family, dominated pairs and single individuals of ducks and geese during the winter months, and defended the territory about themselves wherever they might be, on land or in the water. The defended territory was not precisely located, but moved with the dominant family.

When there is a recognition both of individuals and of territory it is impossible as yet to separate the two. In such cases the question concerns the extent to which the individual plus his territory is the unit in the flock organization, as contrasted with either the individual or the territory as the basic unit.

What are the long-run biological effects of group organization at the level of which we are speaking? And what are the known factors that make for dominance? Our observations on flocks of chickens and other birds and on groups of other animals throw some light on these questions.

As to the first: The results of the fact that the highest-ranking hens lead the freest lives and low-ranking ones are harassed can be shown, among other ways, by studies on egg production. Hens from the lower half of the peck-order lay fewer eggs than their more dominant sisters, even when both come from the same genetic strains.[7] The egg-laying performance of the submissive hens can be much increased by segregating them from their domineering sisters. This is half of the story.

The other half is concerned with the relation between the peck-order among hens and mating behavior. Mr. Alphaeus Guhl, of the University of Chicago, has kindly allowed me to make a preliminary announcement concerning some of his unpublished work on this subject. He has had experience with several cocks placed successively or in groups of four with different flocks of hens, and has found practically no correlation between frequency of copulation and the social status of the hen.

Mr. Guhl also determined the peck-order in different groups of cocks; again there was no significant relationship between the social standing of the cock in relation to his fellows and the frequency of his mating when introduced alone into a flock of hens who were well accustomed to his presence.

When, however, the four cocks of a given flock were all placed together in an uncrowded pen of hens, there developed a type of psychological castration of the low-ranking males which, in some individuals, became practically complete. The details of the whole complicated story have much interest. I can take space for only one example.

The cock Y stood second to R in the peck-order of the males. Y was sexually aggressive and successful in a rough, forceful way when he was alone with the hens. When the four cocks and seven hens were placed together, the *alpha* cock R would charge at Y and drive him to the roosts whenever Y approached the hens. Meantime the hens would all scatter and fly to any available perch. Y soon learned to spend less and less time on the floor and the hens learned to run when he came down to feed. Y lost weight during this period and his food hunger increased. For practical purposes Y was no longer sexually effective.

Interestingly enough, these birds show what we can call favoritism as well as antagonism. Thus the dominant R did not similarly persecute cock G but even allowed him to interfere with R's own courting, and that without punishment.

When Y was placed with another flock of hens he was uninhibited sexually. Placing cocks with strange flocks is known to increase their sexual activity. However, later, when Y was again placed alone with the hens that he had been conditioned not to tread, not only did he attempt to copulate less frequently than before he was psychologically castrated, but it was also found that the hens had been conditioned against allowing him to tread them.

Conditions such as I have been reviewing indicate that social position in the flock may affect the opportunity of a given male or female for leaving numerous offspring. Those high in their respective peck-orders have the better opportunity for becoming parents of the next generation, as a result of the hen's greater freedom for egg production and of the cock's freedom for copulation.

So much for individual selection as a result of social status. There is a still more important problem in selection to be outlined. Is an organized group sufficiently different from an unorganized one at this level so that selection of the whole lot can occur?

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[7] W. C. Sanctuary, Master's thesis deposited in the library of Massachusetts State College, Amherst, Mass., 1932.

We are coming to realize that groups of animals and other more-or-less integrated population units can be selected somewhat as though they were individuals. In fact, some of us think that natural selection of such populations, rather than natural selection of individuals, is the important basis of evolution. There is no experimental evidence with regard to the selection of organized as contrasted with unorganized groups. I believe the problem is open to experimental attack and if we had had space available, such an attack would have been under way.

We shall turn from this to consider some of the factors that make for social dominance. Dominance-subordination patterns of behavior may be based on the recognition of other members of the flock as individuals to which a proper reaction must be made. This is the method which obtains in many social groups of men, and in all the flocks of birds which we have studied. Opposed to this is a type of impersonal behavior pattern such as is found in many of the groups of mice which have been studied in our laboratory, especially by Dr. Uhrich[8] and Mr. Benson Ginsburg. Impersonal group organization depends upon a kind of unoriented, generalized aggressiveness brought in contact with similarly unoriented lack of aggressiveness. This is a type of statistical relationship in which a very bellicose animal dominates its own or foreign groups as a result of his high degree of bellicosity. A dominance-subordination system of behavior with such a basis does not represent the same social mechanism as does one which depends on individual recognition, although the two systems may be related.

Small lots of male mice caged together develop a social order as just suggested which is based on relative aggressiveness and general fighting ability. The order is not as stable as that found among hens, but it is sufficiently stable to allow experimentation when this is carefully controlled.

In the work with hens and in early work with mice, there had been suggestions that a succession of victories tended to condition the individual to be victorious in the next contest, while a series of defeats had the opposite effect. Mr. Ginsburg and I turned to mice in order to make a direct test of this interesting lead.

The ease of experimentation was made greater by the discovery by Dr. J. P. Scott[9] of hereditary strains of highly inbred mice which differed decidedly in fighting tendencies and abilities.[10] Roughly speaking, we had available a belligerent strain which was black in color; a strain of pacific mice bearing white coats, and an intermediate agouti strain which generally lost to the blacks and usually won from the whites.

These differences in fighting prowess made it possible to expose a high-ranking mouse from the passive white strain to repeated defeats from the belligerent blacks, and then test the effects of such experiences by again staging intra-strain combats among the white mice. Or, on the other hand, an attempt could be made to "build up" a low-ranking brown or black mouse by repeated contacts with the submissive whites.

After some 60 fights among themselves, W 1 emerged as the dominant mouse of a group of five white males, and held that status during the next 140 fights. Since this order seemed to be stable, the time was ripe for experimentation. Accordingly, W 1 was matched with B 2, the *alpha* mouse of the aggressive blacks, twice a day for eight days. B 2 attacked aggressively even when W 1 was entirely passive. When again matched with his fellow whites, W 1 submitted to every opponent, including even the very passive *omega* white mouse. After some 180 fights among themselves, W 1 regained aggressiveness and again became dominant over the white mice. Even so, he remained passive when matched against even the least aggressive of the belligerent blacks.

Our experience with other mice indicates that if W 1 had met more active resistance from its own group, it would probably have been even slower to reassume aggressiveness. In fact, when W 2 was similarly conditioned downward and then returned to face the other white mice, it was attacked by the dominant W 1 and showed a submissive attitude toward all, until after a series of mild encounters with the *omega* mouse of these pacific whites it again became somewhat aggressive.

It is much easier to cause an intermediate mouse to lose social status by repeated defeats than it is to do the same with a dominant individual. Such an intermediate animal has already been partly conditioned toward submission as a result of losses to the more dominant members of its own group. When intermediate mice were conditioned downward and then kept from meeting dominant mice in their own group, they recovered social confidence just as a dominant individual does under similar conditions.

The dominant white mouse, W 1, was given a longer and more severe experience with repeated defeats. As a result he became so passive that he showed no resistance whatever, and throughout the ensuing two months, he was submissive to all the members of the group which he had formerly dominated. For a time he gave the submissive reaction whenever another mouse came near him; later, only when he was actively threatened. He continued, however, to give up immediately in the face of any show of aggressiveness in another mouse. He regained aggressiveness after being isolated for four months.

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[8] J. Uhrich, *Jour. Comp. Psychol.*, 25: 373–413, 1938.

[9] J. P. Scott, *Anat. Rec.*, 78: No. 4. Supp., 1940.

[10] I am indebted to the Jackson Memorial Laboratory for the gift of these mice.

Generalizing from a considerable extent of such experience, we have found that it is relatively easy to condition a mouse downward in its social scale, and that the longer and more severe the conditioning, the more lasting the results. We have found that it is also possible to so train a less aggressive mouse that it will become more dominant. This can be done even with low-ranking mice in the most pacific strain. But while it is possible, it is difficult to arrange social contacts such that a mouse at the very bottom of the group organization will show increased social aggressiveness. The training toward aggressiveness goes exceedingly slowly and must be modified to meet the nuances in the behavior of each individual. As in causing mice to lose social status, it is much easier to train intermediate mice to be aggressive than those which are low in the social scale.

One example must suffice. I choose this particular case since we have a motion picture record of the final battle of such a long conditioning series.

Br 6 was at the bottom of the social order among the agouti mice. He was almost completely nonaggressive. Finally Br 6 was mated; and low-ranking, passive white mice were introduced into his home cage. Br 6 had never before made an attack, but now, in the presence of his mate, he threatened and fought off the mild invaders. Even this show of aggressiveness did not carry over in the absence of a female, and it took six weeks of careful social manipulation combined with a judicious use of isolation, which in these mice helps to build aggressiveness, before Br 6 finally attacked one of the whites when the two were alone together in a neutral cage. After this he was made to encounter several low-ranking whites daily in the fighting cage, and as a result of the total build-up he became definitely aggressive.

The extent of his aggressiveness is indicated by the fact that within an hour after a defeat by B 1, the fightingest mouse we had, he vigorously counterattacked and defeated his immediate superior in the social scale among the agoutis. He also won from other superiors after we had taken the precaution to have these fights staged soon after the latter had been defeated.

Meantime we wanted a good hard fight for the motion picture record. B 2, the dominant black, had just suffered two of his rare defeats and was nursing a lacerated shoulder. Even so, he was an aggressive, hard-fighting mouse. Somewhat optimistically we matched Br 6 against him. It is fortunate that we have a visual record of one of the most decisive interstrain combats seen in this laboratory. Br 6 lost but only after fighting so hard that he died a few minutes later. There can be little question of the efficiency of the upward conditioning in this case.

And now a few final paragraphs. The socially dominant animals we have been discussing may or may not be the leaders in their groups. The *alpha* hen in a penned flock does not necessarily lead in foraging expeditions when the hens are turned out into an open lot. In fact, in such a foraging flock leadership changes frequently and the bird at the apex seems always more or less dependent on her followers. With certain other birds, in the flying flocks of which the different individuals can be recognized, the one in front is at times merely the fastest bird in the flock. So far as true leadership is concerned, it is only following along ahead of the main flock. A somewhat similar relationship between leader and followers has been observed among other animals, notably with ants and with men.

In the female herd of cows the dominant animal is the leader. With certain species of deer the female also leads, even when males are present; with other species the male is the leader.

The final point I have to make is a disappointingly negative one: I have said that group organization with a dominance-subordination pattern occurs among a wide variety of vertebrate animals, but the bearing of these patterns on leadership is another matter. While we now know how to study the problem of leadership in an objective and comprehensive way, actually very little progress has been made in such studies upon non-primate animals.

We do know, from experimental analysis, that the dominance-subordination pattern of group behavior may be influenced by environmental factors and may have its foundations in (a) heredity, as shown by different degrees of aggressiveness in different genetic strains; (b) in the physiological state of the individual, one phase of which is illustrated by studies on the hormonal control of dominance; and (c) on experience which with hens and mice may be recent, or remembered from the relatively remote past.

OBITUARY

JOHN ALEXANDER McGEOCH

In the prime of his career, occupying a position of leadership in American psychology, the life of Professor McGeoch was cut short by his untimely death in Iowa City on March 3, 1942. He died of a cerebral hemorrhage after a short illness.

Professor McGeoch was born in Argyle, New York, October 9, 1897. He received his A.B. degree from

Westminster College in 1918 and his M.A. degree from Colorado College in 1919. He received his Ph.D. from the University of Chicago in 1926, after having done part of his graduate study at the University of California and at Columbia University. In 1924 he married Grace Oberschelp, who died in 1927; and in 1939 he married Mrs. Frances Hady, who with her two children, and his mother, Mrs. Alexander McGeoch, survive him.

He came to Iowa as head of the department of psychology in the fall of 1939, and while here he has won high recognition for his scholarly activities in the pursuit and promotion of research, his excellence in teaching and administrative activities, his good judgment and winsome personality, and his trustworthy leadership in the department and in the university as a whole. His researches have centered around problems in the psychology of learning. He had just completed his magnum opus, a volume entitled "The Psychology of Human Learning," which is being published by Longmans, Green. He has served as editor of the *Psychological Bulletin* since 1935, and has published a number of papers, principally in the field of experimental psychology in education.

Professor McGeoch has been active in the American Psychological Association, the American Association for the Advancement of Science (secretary, Section I, 1934–1936), the Eastern Psychological Association, the Midwestern Psychological Association (secretary-treasurer, 1932–1934; president, 1935), the Society of Experimental Psychologists, the Southern Society for Philosophy and Psychology, and the National Institute of Psychology (president, 1941). He was a member of Sigma Xi, Phi Beta Kappa, Phi Delta Kappa and Phi Sigma. He served as instructor of psychology at Washington University, 1920–1922; assistant professor, 1922–1926; and associate professor, 1926–1928; professor of psychology, University of Arkansas, 1928–1930; professor and chairman of the department of psychology, University of Missouri, 1930–1935; research professor, Wesleyan University, 1935–1939, which position he left to come to the University of Iowa.

CARL E. SEASHORE

THE STATE UNIVERSITY OF IOWA

RECENT DEATHS

SIR WILLIAM BRAGG, Fullerian professor of chemistry and director of the Royal Institution, London; director of the Davy-Faraday Research Laboratory; from 1935 to 1940 president of the Royal Society, died on March 13 in his eightieth year.

DR. ROBERT WILLIAM HEGNER, professor of protozoology and head of the department of medical zoology at the Johns Hopkins University, died on March 11 at the age of sixty-two years.

DR. KARL MCKAY WIEGAND, professor emeritus of botany, formerly head of the department at the New York State College of Agriculture at Cornell University, died on March 12 at the age of sixty-eight years.

DR. ROBERT WILSON SMITH, professor emeritus of biology, McMaster University, Hamilton, Ontario, died on February 22, in his eighty-second year.

SCIENTIFIC EVENTS

THE ROYAL OBSERVATORY AT THE CAPE OF GOOD HOPE[1]

THE report for 1940 of H.M. Astronomer at the Cape of Good Hope illustrates how astronomical work in the belligerent countries is being affected even though they may be far removed from the present scene of hostilities. Half the observing staff at the Cape is now engaged on non-astronomical duties, this at a time when so many observatories in Europe have perforce suspended work. Nevertheless, the depleted staff is doing its best to secure such observations as can not be replaced by any made at a later date. Meridian observations of the moon have been started in view of the possible loss of European observations, and volunteers have come to the rescue in observing occultations. Photographic work has been somewhat precarious owing to delays in the delivery of plates, but few photographs have been lost, and the position has been eased by a modification of the program of routine solar observations which supplements that still being carried on at Greenwich. Work on the Reversible Transit Circle continues on a somewhat reduced scale, and the photometric observations are now sufficiently far advanced to make possible the construction of a framework of stars of magnitudes between 7 and 10 to which the magnitudes of the zone stars can be referred. With the 1940 batch of parallaxes the observatory now enters the very restricted list of stations at which the distances of more than a thousand stars have been determined trigonometrically.

The section of the report which will be read with perhaps the greatest interest concerns the total solar eclipse of October 1, 1940. The main part of the program was to measure the gravitational deflection of light in the sun's field—the Einstein effect. The Greenwich expedition which was to have cooperated in this work was cancelled at the outbreak of war, and the entire program was carried through, as planned, by the Cape staff. It is disappointing to have to record total failure in this part of the work. The field of stars close to the eclipsed sun was known beforehand to be a poor one; but eclipses are so few and far between that the attempt seemed justified. In fact, the lessened exposure time and reduced aperture necessary to prevent fogging of the plates by the rather bright sky, combined with the poor daytime "seeing" on the Karroo to prevent any stars showing on the negatives at all. Astronomers all over the world will sympathize with H.M. Astronomer and his staff in this disappointment, particularly as observing conditions were otherwise good. Their sole compensation was in securing the only large-scale photographs of the corona obtained during this eclipse—photographs which, though interesting and indeed important, represent a most inadequate reward for months of work.

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[1] From *Nature*.

NEW KODACHROME SLIDE SERIES OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE department of education of the American Museum of Natural History has made available to schools and colleges the first teaching series of kodachrome lantern slides to be offered by any institution. The "Evolution of the Horse" is the title of this set of twenty-five slides made up in the 2 × 2 inch size.

The late Dr. Walter Granger, paleontologist at the American Museum, endorsed the accuracy of the slides which are reproductions of exhibits in the museum.

A process of duplicating kodachrome pictures has been developed by the museum, so that careful control of the color of the final slide is maintained. The original photographs of the exhibits are made on the larger kodachrome sizes so as to retain as much detail as possible. These large pictures are then rephotographed down to the thirty-five millimeter size using an artificial light source accurately adjusted as to color temperature. A complete series of faint complementary color correction filters makes it possible to adjust the hues of the final slides to as close a duplicate of the original colors in the museum exhibits as is necessary to maintain fidelity.

The "Evolution of the Horse" series contains maps of the chief fossil deposits in the United States, pictures of the formations in which the fossils are found, a progressive series of the fossil horse skeletons, Charles R. Knight's paintings of restorations of the fossil horses and the contemporary life of each period. Slides comparing the skulls, hooves and overall size of the earliest and modern horses complete this series. A special manuscript has been written describing the slides and the story of "The Evolution of the Horse."

This set of slides is the first of several that are planned. The Story of the Dinosaur and Ancient Man will follow soon. The "Evolution of the Horse" is already in use in the high schools of New York City.

FOREST FIRE PROTECTION

THE American Forestry Association, in an open letter to the Congress, urges that forest fire protection be placed on a war-time basis. Shortage of employable labor in the forest regions because of military service and demands of war industries, coupled with the curtailment and diversion of the CCC, heretofore an important link in forest fire protection, were given as reasons for the growing fire peril to vital timber resources.

Recommendations that a war priority rating be given forest protection and that the CCC be reappraised in the light of a streamlined, mobile resource protection force with the status of an essential war agency were made by the association.

Back of these recommendations is the important fact that forest resources are now being heavily drawn on and must continue to be heavily drawn on in the prosecution of the war. According to the association, the war already has called for 2,500,000,000 feet of lumber from the nation's forests, and the War Department has let contracts for upwards of a billion feet more. Wood is needed in great volume for airplanes, cargo and fighting ships, construction of training camps and cantonments, crates for shipping food and equipment to the battle fronts, and scores of other war-needed products. Protection of such a vital war resource is an immediate and major concern to the Congress and to the nation. It is pointed out in the letter to the Congress that

> Failure to make provision to assure adequate protection of these resources during seasons of the year when it is known they will be exposed to critical danger, may easily disrupt and delay our all-out plans to win this war. Forest fires do not wait for man to organize after the fire season arrives. They can be dealt with successfully only by advance organization, planning and preparedness. The question as it now presents itself appears to be primarily one of providing necessary man power in advance through centralized governmental action instead of leaving it to regional protective agencies to compete with one another for labor and to be short-handed and unprepared when critical forest fires break out.

COMMITTEE OF EXAMINATIONS AND TESTS OF THE AMERICAN CHEMICAL SOCIETY

THE Committee of Examinations and Tests, Division of Chemical Education, of the American Chemical Society, has announced that the 1942 Cooperative Chemistry Test will be available by April 1. Inquiries should be addressed to the Cooperative Test Service, 15 Amsterdam Avenue, New York City.

The accumulation of data and experience of the past six years has had the effect of modifying the concept of what a test should measure and how this should be accomplished. As a result of extensive discussion at a conference, held at the University of Chicago last June, the 1942 form of the test is considerably different from the tests of the past four years. The test has been administered in a preliminary form to determine the difficulty and validity of each item, and the committee hopes for its wide-spread adoption. A brief description of the test follows:

Part I. General Knowledge and Information.

This section is based on knowledge of our acquaintance with important facts, definitions, laws and theories of chemistry. Historical events and application of chemistry to the social and economic world are represented.

Part II. Application of Principles.

This part attempts to measure the ability to solve numerical problems, to balance equations and to make quantitative predictions by the application of chemical principles.

Part III. Scientific Method.

This section is concerned with the understanding of the relation of observation, definitions, laws, theories in the scientific procedure. The relation of theory to experiment is represented, as well as the ability to interpret chemical data.

Part IV. Knowledge of Laboratory Technic and Procedure.

This new section is included in the effort to measure acquaintance with the laboratory and knowledge of "correct" procedures. It does not attempt to measure skill or technic *per se.*

The committee which is sponsoring the test is comprised of the following members of the Division of Chemical Education:

B. Clifford Hendricks, University of Nebraska; Rufus D. Reed, New Jersey State Teachers College; Ed. F. Degering, Purdue University; Laurence S. Foster, Brown University; Earl W. Phelan, Georgia State Womans College; Theodore A. Ashford, University of Chicago, and Otto M. Smith, Oklahoma Agricultural and Mechanical College, *chairman.*

AMERICAN STANDARDS FOR 1942

THE American Standards Association has announced the publication of its new list of American Standards for 1942. This announcement points out that in view of the importance of standards and specifications, not only for every-day work but to speed up production for defense, this particular list of standards should be in the hands of the engineering and purchasing departments of every manufacturing firm in the United States.

Nearly 500 American Standards are listed in a wide variety of industrial fields and in the fields of industrial and public safety. There is a separate heading for American Defense Emergency Standards—standards developed specifically for defense purposes, and for the first time all American Safety Standards are listed together in a separate section.

The standards include definitions of technical terms, specifications for metals and other materials, methods of test for the finished product, dimensions, safety provisions for the use of machinery and methods of work. They reach into every important engineering field, serving as a basis for many municipal, state and federal regulations.

In each case these standards represent general agreement on the part of maker, seller and user groups as to the best current industrial practice. More than 600 organizations are taking part in this work. The standards are frequently reviewed and revised in order to keep them in line with changing industrial needs. New standards, and those brought up to date within the year, are especially marked in the list.

The list will be sent free of charge to any one writing in for it. Requests should be addressed to the American Standards Association, 29 West 39th Street, New York, N. Y.

WAR WORK OF THE DEPARTMENT OF PSYCHOLOGY OF YALE UNIVERSITY

THE following members of the department of psychology of Yale University are working full- or part-time in work in connection with the war:

Leonard W. Doob, social psychologist who is on leave of absence from the university, is employed now with the Office for Emergency Management in Washington. He is in charge of the analysis section of the Office of the Coordinator of Inter-American Affairs, under Nelson Rockefeller. In this capacity, he supervises a staff in the analysis of public opinion in Latin American republics, and Axis propaganda directed at them. He also analyzes the effects of American activities in this respect and makes recommendations to all divisions of the office on the basis of his findings. Doob is the author of "Propaganda."

Neal E. Miller has recently been granted a leave of absence to accept a commission in the Army Air Force, where he is engaged in the pilot selection program and in research on problems of emotional adjustments in aviators.

Judson S. Brown, instructor in psychology, has been commissioned first lieutenant in the Army Air Corps and will be engaged in psychological research under the direction of Colonel Harry G. Armstrong.

Several members of the department, including Mark A. May, Neal E. Miller, Judson S. Brown and Robert R. Sears have been engaged in New Haven in the Air Raid Warden Training Program giving addresses on the prevention of panic.

Walter R. Miles, professor of psychology, is a member of the National Research Council, studying aviation medicine, sound control in vehicles, aircraft pilot selection and training and night vision. He is chairman of its Emergency Committee in Psychology. He is also chairman of the National Research Council Committee on Problems of Neurotic Behavior.

Robert M. Yerkes, professor of psychobiology, is expert consultant to the War Department and a member of the National Research Council's Emergency Committee in Psychology.

Carl I. Hovland, assistant professor, is co-author of the intelligence tests used by the Navy Air Corps in selecting candidates. He is unofficial adviser and consultant in aviation testing both in this country and in Canada. In addition, under the auspices of the War Production Board, Hovland is statistician and industrial psychologist for a group studying working arrangements in war industries. He has recently been appointed expert consultant to the Secretary of War.

THE AMERICAN SOCIETY OF NATURALISTS

At the recent Dallas meeting of the American Society of Naturalists, officers were elected as follows: Dr. Ralph E. Cleland, professor of biology and chairman of the department, Indiana University, *president;* Dr. L. C. Dunn, professor of zoology, Columbia University, *vice-president* for the next year, and Dr. Malcolm R. Irwin, professor of genetics, College of Agriculture, University of Wisconsin, *treasurer* for three years. Dr. A. C. Kinsey, Indiana University, continues as secretary for a period of three years.

At the same meeting, the following persons were elected members of the society on account of outstanding achievement in biological research:

B. G. Anderson, Western Reserve; P. B. Armstrong, Syracuse, L. G. Barth, Columbia; F. A. Beach, American Museum of Natural History; Charles M. Breder, Jr., New York Aquarium and American Museum; J. W. Buchanan, Northwestern; W. Burrows, Chicago; D. P. Costello, North Carolina; J. N. Couch, North Carolina; P. S. Galtsoff, U. S. Bureau of Fisheries; V. Hamburger, Washington; A. Hollaender, U. S. Public Health Service; Clay G. Huff, Chicago; Libbie H. Hyman, American Museum of Natural History; George W. Kidder, Brown; L. H. Leonian, West Virginia; Howard S. Liddell, Cornell; N. E. McIndoo, U. S. Bureau of Entomology; Clarence P. Oliver, Minnesota; Roberts Rugh, New York; F. O. Schmitt, Washington; G. L. Stebbins, Jr., California; Ivon R. Taylor, Brown; H. B. Tukey, Cornell; B. W. Wells, North Carolina State College; E. T. Wherry, Pennsylvania; D. M. Whitaker, Stanford; Truman G. Yuncker, De Pauw.

SCIENTIFIC NOTES AND NEWS

Dr. William J. Gies, professor emeritus of biochemistry at Columbia University, was the recipient on his seventieth birthday on February 21 of congratulatory messages from dental organizations throughout the nation. Dr. Gies was the organizer of the International Association for Dental Research, founder of the *Journal of Dental Research,* director of the Carnegie Foundation Study of Dental Education in the United States and Canada and a leader in the organization of the American Association of Dental Schools.

A life fellowship in the Thomas A. Edison Foundation for the Advancement of Science and Education has been conferred upon Dr. Robert Gordon Sproul, president of the University of California. The award is given to "only a few outstanding Americans in the fields of medicine, science, art and education, who have made some real contribution to human welfare."

The 1942 Hillebrand Award of the Washington, D. C., Section of the American Chemical Society was presented to Dr. Michael X. Sullivan, director of the Chemo-Medical Research Institute of Georgetown University, in recognition of his work in measuring important chemical constituents in living organisms. The presentation ceremony was held on March 12 at the Cosmos Club, Washington, D. C.

The three hundred and eleventh meeting of the Washington Academy of Sciences was held on March 19 at the Cosmos Club. The meeting was devoted to the presentation by the academy of its awards for scientific achievement for 1941. These are: For the *Biological Sciences,* G. Arthur Cooper, U. S. National Museum, "in recognition of his distinguished service in invertebrate paleontology, notably for his discovery of anatomical structures hitherto unknown"; for the *Engineering Sciences,* Theodore R. Gilliland, National Bureau of Standards, "in recognition of his distinguished service in originating automatic ionosphere recordings of continuously variable radio frequencies"; for the *Physical Sciences,* Sterling B. Hendricks, U. S. Bureau of Plant Industry, "in recognition of his distinguished service in determining the constitution of micaceous and other complex minerals."

At the annual dinner in New York on March 13 of the Society of Automotive Engineers, the Wright Brothers Medal was awarded for last year's "outstanding contribution to aeronautical knowledge" to Samuel J. Loring, vibration engineer for the Vought-Sikorsky division of United Aircraft. Dr. J. C. Hunsaker, chairman of the National Advisory Committee for Aeronautics, presented the award to Mr. Loring, whose paper on high-speed flutter in aircraft was read before the society a year ago.

Dr. H. de Forest was the guest of honor at a dinner given recently by the Botany Club and Phi Sigma, honorary biological fraternity, to celebrate his twenty years of service at the University of Southern California. He was presented with a radio set.

Dr. John Harvey Kellogg, since 1876 medical director and surgeon of the Battle Creek Sanitarium; founder and medical director of the Miami-Battle Creek Sanitarium; founder and president-emeritus of Battle Creek College, was the guest of honor on February 26 at a dinner given by the Battle Creek chamber of commerce and the county medical society. An inscribed scroll was presented to him.

At the Dallas meeting of the American Society of Zoologists the following officers were elected: *President,* L. L. Woodruff, Yale University; *Vice-president,* C. G. Hartman, University of Illinois; *Secretary,* L. V. Domm, University of Chicago; and *Treasurer,* H. W. Beams, State University of Iowa.

The Columbia University Chapter of Sigma Xi has elected Dr. Victor K. LaMer, professor of chemistry, to succeed Dr. Selig Hecht as president of the society. Professor Jan Schilt, head of the department of astronomy, has been elected vice-president.

Dr. David Brunt, professor of meteorology at the Imperial College of Science and Technology, London, has been elected president of the Royal Meteorological Society.

Dr. Peter Frandsen, professor of zoology and bacteriology and head of the department of biology of the University of Nevada, for forty-one years a member of the faculty, will retire at the close of the academic year.

Dr. Louis M. Heil, research associate in science at the University of Chicago, has been made head of the department of physics at Cooper Union with the rank of full professor. He will succeed Professor Albert Ball, who retires on June 30 after thirty-seven years of service.

Dr. Otto Loewi, Nobel laureate and research professor of pharmacology at New York University, will be at the University of Washington in Seattle for the spring quarter. He will conduct a series of weekly seminars on Tuesday evenings, beginning on April 28, on autonomic drugs, the sensitivity of denervated organs, the chemical determination of the nervous impulses and related topics. Four public lectures are also planned covering the general aspects of the chemical mediation of nervous activity, regulation of the organism and drug action and drug activity.

Dr. H. C. Sherman, Mitchill professor of chemistry and head of the department at Columbia University, has been appointed vice-chairman of the Food and Nutrition Board of the National Research Council and a member of its executive committee and of its standing committee on research.

Dr. Waldo Shumway, professor of zoology in the University of Illinois, has been called to field duty in the U. S. Army as a major of infantry. From 1917 to 1919 he served as a first lieutenant in the 103d Infantry, A. E. F.

Professor C. K. Leith, of the University of Wisconsin, at present adviser to the Materials Division of the U. S. War Production Board, has been giving a series of ten lectures under the auspices of the division of geology and geography of Columbia University, entitled "Minerals in Peace and War."

Dr. James S. McLester, professor of medicine at the School of Medicine of the University of Alabama and past president of the American Medical Association, will deliver the Hermann M. Biggs Memorial Lecture at the New York Academy of Medicine on April 2. He will speak on "Nutrition and the Nation at War."

Dr. Paul R. Heyl, of the National Bureau of Standards, spoke on March 14 before the Philosophical Society of Washington. His address was entitled "A New Determination of the Constant of Gravitation."

Dr. H. A. Bethe, professor of physics at Cornell University, is delivering Sigma Xi lectures at the following institutions: Washington and Jefferson College, Swarthmore College, North Carolina State College, Brown University, Western Reserve University and the Illinois Institute of Technology.

Dr. Marion Hines, associate professor of anatomy at the Johns Hopkins Medical School, gave the Howe Lecture of Ophthalmology on March 17 at the Harvard Medical School. The subject of the lecture was "Recent Contributions to the Localization of Vision within the Central Nervous System."

The annual meeting of the Division of Anthropology and Psychology of the National Research Council will be held in Washington on Saturday, April 25.

The Kentucky Academy of Science will hold its twenty-ninth annual meeting at the University of Kentucky on April 10 and 11, with divisional groups holding sectional meetings. These groups will include the Kentucky branch of the Society of American Bacteriologists; the divisions of biology, chemistry, mathematics, physics, psychology and philosophy, and the Kentucky Geological Society.

A conference on "Color, Constitution and Reactions of Dyes" will be held at the American Museum of Natural History on March 27 and 28 by the Section of Physics and Chemistry of the New York Academy of Sciences. There will be an informal subscription dinner on Friday evening.

THREE chapters of the Society of the Sigma Xi, the national honorary society for the promotion of research in science, are being installed during March. The Utah State Chapter was formally installed at the Utah State Agricultural College, Logan, on March 14. After a convocation in the morning and formal installation ceremonies in the afternoon, there was a dinner, followed by an address on "The Structure of Liquids," by Dr. John G. Kirkwood, professor of chemistry at Cornell University. A chapter at the Louisiana State University, at Baton Rouge, will be installed with appropriate ceremonies on March 24. At the Illinois Institute of Technology, Chicago, a new chapter will be installed on March 25, with Dr. Ross A. Gortner, professor of agricultural biochemistry at the University of Minnesota, and Dr. George A. Baitsell, of Yale University, national secretary, as the installing officers.

THE Committee on Scientific Research of the American Medical Association invites applications for grants in support of researches on problems more or less closely connected with clinical medicine and public health. For information address the committee at 535 N. Dearborn Street, Chicago, Ill.

A UNITED PRESS dispatch, dated from Chicago on February 15, states that the Council on Medical Education and Hospitals of the American Medical Association has dropped the Medical School of the University of Georgia from its list of approved schools. A resolution to this effect was adopted at a business meeting and was signed by the chairman of the council, Dr. Ray Lyman Wilbur, president of Stanford University. In sending copies of the resolution to the chancellor of the university and the dean of the medical school, it is pointed out that its action was "without prejudice to students now enrolled." It was said informally that the action of the council expressed the disapproval of the dismissal of several members of the faculty after Governor Eugene Talmadge accused them of advocating "race equality."

IT is stated in ***Museum News*** that the committee on education and participation in science of the American Philosophical Society, Philadelphia, terminated its work on February 2. Plans of W. Stephen Thomas, executive secretary of the committee, to enter military service determined the committee's action in bringing the enterprise to a close. Mr. Thomas, who was formerly in charge of the educational department of the Academy of Natural Sciences of Philadelphia, had carried the burden of the enterprise from its beginning in 1939. The committee, under the chairmanship of Dr. Edwin G. Conklin, executive vice-president of the American Philosophical Society, undertook a survey of adult education in science in the Philadelphia region and the promotion of participation of adults in discussion forums, laboratory courses, museum tours, field trips, research in science and other activities. The organization of the Philadelphia Council of Amateur Scientists was an outgrowth of the committee's work. The committee published a monthly circular of activities in science in the region.

THE second National Chemical Exposition sponsored by the Chicago Section of the American Chemical Society, will be held from November 17 to 22 at the Stevens Hotel in Chicago. It is reported that more than 60 per cent. of available exhibition space, double the area of the first exhibit held in December, 1940, is already under contract with leading firms throughout the country. Victor Conquest, director of research for Armour and Company, is chairman of the committee in charge of a National Industrial Chemical Conference to be held in conjunction with the exposition, the program for which is now being arranged. It will be addressed by leaders in the chemical industry. It is announced that many scientific societies are planning to hold their meetings in Chicago during the period of the exposition.

IN reply to a telegraphed request from the National Safety Council for cooperation in President Roosevelt's war against accidents, the American Standards Association has made public the following statement: "The American Standards Association, the national standardizing body in the United States, whose membership consists of leading industries, most of the departments and administrations of the Federal Government and the leading technical organizations of the country, including the National Safety Council, offers its complete cooperation in the effort of the council to comply with President Roosevelt's request that it lead a campaign against accidents of all kinds that are hampering the National Defense Program. The development of national safety standards prescribing methods of removing accident hazards and conducting processes in a safe manner is essential to any nation-wide accident prevention campaign and has long been a most important part of the American Standards Association national standardization program. The sixty standards already developed will enable the council to present recommendations to the groups contacted in the campaign. An Emergency Procedure for the development of standards essential to national defense has been established by this association. This and other facilities of the association are offered for use in your campaign."

DISCUSSION

INSECTS AND EPIDEMIOLOGY OF POLIOMYELITIS*

In Science for February 13, Professor Charles T. Brues discussed our report on flies as carriers of poliomyelitis virus[1] and probably expressed the feeling of many entomologists when he referred to our description of the insects as "naively vague" although he was kind enough to add "for an otherwise carefully executed experiment." The purpose of this communication is to remove some of this "naive vagueness" by reporting certain data which have come to light since the publication of our original note, and to comment on the possible role of insects in the epidemiology of poliomyelitis.

When it is recalled that at the beginning of our experiments there was no valid evidence of the existence in nature of non-human carriers of poliomyelitis virus, it will not be difficult to understand why in the first tests we included all insects found in our traps even the caterpillar, "four-winged insect," moth and bee. The first part of the job was to determine whether insects are carriers and the second part, which ones. By this time we have been able to demonstrate the presence of poliomyelitis virus in 8 of the 15 batches of flies trapped during outbreaks of the disease in Atlanta and Cleveland. If we had tested relatively large quantities of the stools of 15 patients during the acute stage of poliomyelitis we could not have expected a very much higher incidence of positive results. And yet it is worth noting that, with one exception, the positive results we obtained were with insects that were not caught in the vicinity of privies. Our patients had been in the hospital for days or weeks and the other probable virus carriers in the city homes used good toilets. Where these insects got their virus is one of the intriguing problems for the future.

The distinctly positive results which we obtained with collections of insects consisting only of flies leaves no doubt that they are carriers of the virus. The proportion of the different varieties of flies present in the virus-positive batches was noted and representative specimens, preserved in the frozen state, were kindly identified for us by Mr. David G. Hall, of the Bureau of Entomology of the U. S. Department of Agriculture. In Atlanta the bait consisted of sliced bananas sprinkled with sugar, and more than 95 per cent. of the flies consisted of *Musca domestica;* the virus was isolated from 1 of 3 batches tested and the flies in the positive sample consisted of 203 specimens of *Musca domestica* and 5 blowflies of which 3 can be classified as *Calliphoridae: Phaenicia sericata* (Mg.). In Cleveland fresh meat was added to the bananas and sugar, and the specimens which were caught and shown to carry the virus consisted of flies, 90 to 95 per cent. of which belonged to the *Calliphoridae* (blowflies) and the remainder to the family of *Muscidae*. The virus was demonstrated in 7 of the 12 batches tested. The large majority of *Calliphoridae* were *Phaenicia sericata,* and only few or rare specimens of the following were encountered: *Phormia regina* (Mg.), *Protophormia terrae-novae* (R.-D.), *Cynomyopsis cadaverina* (R.-D.) and *Calliphora erythrocephala* (Mg.). The *Muscidae* were mostly *Musca domestica* L. with only occasional representatives of *Muscina stabulans* (Fall.) and *Ophyra leucostoma*. Virus was isolated from one collection of flies in which only *Phaenicia sericata* (green bottlefly), *Protophormia terrae-novae* (black blowfly) and *Musca domestica* were present. While it is possible that a variety of species of the *Calliphoridae* and *Muscidae* can carry the virus, future studies with more specific baits and careful selection of individual species will greatly elucidate this question. It should be noted that we were unable to obtain positive results with Rhesus monkeys, and because Cynomolgi are needed, these studies will probably have to be postponed until importation from Java is again possible.

Because we have recently been able to demonstrate the presence of poliomyelitis virus in the blood of Cynomolgus monkeys paralyzed after oral infection with a strain of recent human origin (unpublished data), we believe that blood-sucking and biting insects should not be completely left out of consideration. Perhaps the reason the experiments of Rosenau and Brues[2] and of Anderson and Frost[3] on the experimental transmission of poliomyelitis from monkey to monkey by means of the biting stable-fly (*Stomoxys calcitrans*) could not be repeated by the same workers nor by others, is that a strain of sufficiently recent human origin may not have been used in the later experiments, rather than that epizoic parasites like fleas may have escaped attention, as Professor Brues suggests.

We can not quite agree with Professor Brues when he says that it is growing "increasingly evident that the spread of poliomyelitis can not be traced to direct human contact nor to indirect contact through healthy human carriers. . . ." Careful investigation of a small outbreak of the disease in a Chicago suburb last summer revealed a striking example of spread by carriers.[4] Furthermore, poliomyelitis has long been reported to occur in the winter, although the virus had not been isolated from winter cases. In recent weeks we have been able to convince ourselves of the existence of winter poliomyelitis by isolating the virus from the stools of one paralytic and one non-paralytic case in Cincinnati in the middle of January, as well as from an apparently healthy younger sibling of each of these patients. Professor Brues is especially inclined to throw suspicion on rats because as he says "the virus can now readily be propagated in certain rodents. . . ." While it is true that Armstrong established *a* strain of poliomyelitis virus in cotton rats and mice in 1939, it is unfortunately not true for numerous strains of virus of human or recent human origin which have been tested in rats and mice since that time. The virus of "spontaneous poliomyelitis" of mice (Theiler's virus) may be pathogenic for cotton rats but is without effect in monkeys.[5] And one of the criteria which we and others have found applicable to the large numbers of poliomyelitis strains that have been isolated from human beings and flies is that while producing paralysis in monkeys they are not pathogenic for mice, guinea pigs and rabbits.

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* Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

[1] A. B. Sabin and R. Ward, Science, 94: 590, 1941.

[2] M. J. Rosenau and C. T. Brues, *Bull. State Bd. Health, Massachusetts*, 7: 314, 1912.

[3] J. F. Anderson and W. H. Frost, *U. S. Public Health Repts.*, 27: 1733, 1912; *ibid.*, 28: 833, 1913.

We believe that the search for a reservoir of poliomyelitis virus among lower animals is worth while and should continue. It is also evident, however, that epidemiologically poliomyelitis seems more to resemble diseases like typhoid fever and dysentery in which the chief reservoir of infection is in human excreta and both direct and insect spread may be possible, rather than some or all of the summer encephalitides where the chief reservoir appears to be in lower animals with spread occurring by means of a specific insect (mosquito) vector. Having isolated the virus from winter cases, we are inclined to regard poliomyelitis as a disease which occurs the year round but has a greater incidence during the summer and autumn because greater dissemination of the virus may be made possible by a number of factors, including insects such as flies.

ALBERT B. SABIN
ROBERT WARD

THE CHILDREN'S HOSPITAL RESEARCH FOUNDATION
AND THE DEPARTMENT OF PEDIATRICS,
UNIVERSITY OF CINCINNATI, COLLEGE OF MEDICINE

PLAGIOTROPIC HABIT OF GROWTH IN NORWAY SPRUCE

LATERAL twigs from the lower branches of Norway spruce trees when used as cuttings yield some rooted cuttings with the new terminal shoot developing at an angle from the vertical. This plagiotropic habit of growth if persistent would be highly undesirable for forest planting stock. Observations of this feature have been made in connection with studies[1, 2] of the vegetative propagation of Norway spruce trees during the past three years.

In one collection of 650 cuttings from trees 26 years old plagiotropic growth was evident in 19.4 per cent. of the cuttings three months after planting. In another collection of 600 cuttings from trees 40 years old plagiotropic growth occurred to the extent of 14.4 per cent. Some of the rooted cuttings were planted outside in a nursery, while others were potted and grown in a greenhouse.

By the end of the first growing season the plagiotropic habit of growth was less evident than earlier. With maturation of the stem tissues a number of the terminal shoots which had been but slightly plagiotropic earlier now assumed a vertical or almost vertical position. This is similar to the growth habit of a lateral shoot of the terminal whorl of a conifer whose leading shoot has been injured or removed. The plagiotropic habit was maintained by some of the shoots throughout the first year but gave way to normal vertical orientation of the terminal shoot in the second year. The habit of growth of the terminal shoots of the trees during the third year was normal and indicates that subsequent growth will be normal. It is believed that an early expression of plagiotropic growth in some rooted cuttings of Norway spruce does not offer a serious objection to the employment of vegetative reproduction of this species.

CARL G. DEUBER

OSBORN BOTANICAL LABORATORY,
YALE UNIVERSITY

A SIMPLE AIR-RAID ALARM

A SIMPLE air-raid alarm system has been developed and installed by the Cranbrook Institute of Science, which would be suited to many other buildings, particularly those already equipped with public-address systems.

A switch and radio volume control unit are placed near the telephone switchboard, over which warnings would be received. The unit controls a bank of radio amplification tubes, which build up the unholy noise of a tone-oscillator tube, the wail of which is controlled by the operator in accordance with the official fluctuating two-minute warning or the steady "all clear" signal. The sound is broadcast through eight-inch permanent-magnet speakers, but two of which were required for our building of five floors. The cost of equipment was approximately $25.00.

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[4] E. A. Piszczek, H. J. Shaughnessy, J. Zichis and S. O. Levinson, *Jour. Am. Med. Asn.*, 117: 1962, 1941.

[5] M. Theiler, *Medicine*, 20: 443, 1941; P. K. Olitsky, *Proc. Soc. Exp. Biol. and Med.*, 45: 339, 1940.

[1] C. G. Deuber and J. L. Farrar, SCIENCE, 90: 109–110, 1939.

[2] C. G. Deuber, *Trans. Connecticut Acad. Arts and Sci.*, 34: 1–83, 1940.

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ENTOMOLOGY AND WARFARE

A YOUNG friend of mine, a keen student of insects, has recently been taken over by the military authorities as an entomologist. He does not know where he will be sent or did not when I talked with him, but he has a keen sense of the possibilities of such a position, and is very enthusiastic about it. Years ago, I met Sir David Bruce in Madeira, and he commented on the great opportunities for work connected with the transmission of disease in the tropics and the unwillingness or inability of most resident medical officers to take up this work, in addition to their regular duties. If our military authorities are now establishing entomological units, with trained workers, in all the places where our troops are stationed in the tropics, the results will certainly be of great importance. Sickness and death will be prevented, and information will be obtained which will be of value in times of peace.

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QUOTATIONS

IMPACTS OF THE WAR ON AGRICULTURAL SCIENCE AS INDICATED BY THE DECEMBER SOCIETY MEETINGS

So many of the scientific societies of agricultural interest hold their annual meetings in late December that this period normally assembles more research workers in agriculture than any other of the year. For this reason these gatherings furnish an unusual opportunity to obtain a cross section of current thought and trends in some of the most important fields. In this respect, the 1941 meetings were no exception. Although formulation of their programs was well advanced before Pearl Harbor, the war and its impacts inevitably permeated whatever was said and done.

Three main groups of these meetings were attended by representatives of the Office of Experiment Stations. The largest in point of numbers and constituent bodies was that at Dallas, Texas, centering around the American Association for the Advancement of Science and including among others the American Phytopathological Society, the Society for Horticultural Science, the Society of Plant Physiologists and the Mycological Society, the Genetics Society and the Potato Association of America. A second group was that of nation-wide social science societies, held in New York City and including among others the American Farm Management Association and the Rural Sociological Society of America. The third was held in San Francisco and included the American Association of Economic Entomologists and the Entomological Society of America. All these groups were largely attended, and there was the customary substantial representation from the Federal Department of Agriculture and the land-grant colleges and experiment stations.

One of the organizations giving special attention to the war situation was the American Phytopathological Society. This society scheduled a panel discussion, sponsored by its extension work and relations committee and having as its topic for discussion Plant Pathology in Relation to National Defense and Post-War Readjustments. The meeting was opened by Director C. R. Orton, of West Virginia, who took up the national emergency programs as to crop production and garden goals and set forth the plant disease program involved. Other speakers drew attention to the opportunity for increased service to Latin America, the fungicide and spray machinery situation and the need of better transmission of research findings to the farm. On this last point, it was stated *that less than half the states now have extension plant pathologists.* In an attempt to remedy some of the difficulties in this direction, a group of southern plant pathologists set aside their original program for a special conference to consider what they might do of a war-time value and formulated simple, specific directions for the control of tomato wilt, sweet-potato wilt and other *Fusarium* wilts of southern crops.

The society as a whole voted to affiliate with the American Society of Agricultural Sciences. Thereby it became the first society in this country to effect association with this good-neighbor group established to promote helpful relationships among the agricultural scientists of the American Republics.

Probably the most significant action of the phytopathologists was their formation of a war emergency committee, consisting of their retiring president, Dr. J. G. Leach, of West Virginia; Dr. E. C. Stakman, of Minnesota; Dr. R. P. White, formerly of the New Jersey Stations; and their newly elected president, Dr. L. M. Hutchins, of the U. S. D. A. Bureau of Plant Industry. Regional representatives for the New England, Middle Atlantic, Southern, Upper Mississippi Valley and Pacific Divisions and representatives for plant quarantine, research, extension and fungicide manufacture were also designated. A tentative program of war services dealt with such matters as the codifying for immediate use of existing information on plant disease prevention, an expanded extension service, redirection of current research programs toward emergency uses and increase of special emergency experimentation, reexamination of long-time basic research projects, intensification of plant disease survey work, tightening of plant quarantines and the holding of regional conferences as a basis for developing coordinated action and research programs to meet war needs in the different areas. Reports were received from several states which indicated that already energetic work was proceeding within the experiment stations to reconstruct their departmental research programs to meet war emergency needs.

The Genetics Society of America adopted resolutions referring to the continuity of fundamental research, now destroyed by war in almost all parts of the world, as "probably the most important investment that can at present be made for the benefit of the post-war period." It urged upon Congress and the Federal Government "the importance of safeguarding the continued prosecution of fundamental research by those institutions which are now supported by Federal funds."

The sociological discussions in New York City centered very definitely around the war situation. One session dealt with rural population and national defense, and another with an agricultural program for defense and the post-war period. Rural health received emphasis in a number of programs, notably in an appeal by Dr. M. L. Wilson, of the U. S. D. A. Extension Service, for a wide use of our knowledge of nutrition in carrying out agricultural policy and by Miss Dorothy Dickens of Mississippi on the family and national defense. There was also a session on rural institutions and national defense, in which the school and the church received special attention. Still another set of papers dealt with the integration of social research in the Americas and cultural barriers to American solidarity. Much interest was shown by the rural sociologists as a group in the organization of their research for maximum effectiveness on a wartime basis and the need of making readily and widely available whatever findings could be synthesized and applied in emergency production.

The entomological meetings at San Francisco naturally drew their attendance largely from the western states, but the problems considered in the various papers and conferences represented the major phases of national entomological effort. One of the most profitable sessions of the economic entomologists developed in the extension section where the entomologists' place in national defense was discussed. It was pointed out that 32 entomologists are following their profession as commissioned officers in the armed forces, 10 of whom are in the Navy and 22 in the Army. In other instances, professional entomologists are cooperating with military authorities in sand-fly and mosquito control, location of camps, etc. The need for adjustments of long-time research projects was mentioned. It was pointed out that large-scale operations are probably essential during the present emergency. Several authorities on insecticides mentioned the shortage of various essential materials. For example, many of the oils needed in the West are now going for aviation purposes; rotenone can no longer be obtained in quantity; enough arsenic is difficult to get at the present time. The association reaffirmed its desire to be of service in any way possible during the present state of emergency and expressed its willingness to cooperate with other groups with which its service may be coordinated.

Thus regardless of the place of assembly or the field of special interest, we find agricultural science mobilizing to render a maximum of assistance. In these meetings plant pathologists in Dallas, rural sociologists in New York City and economic entomologists in San Francisco alike demonstrated the solidarity of the personnel engaged in agricultural research in the nation and by typically democratic procedures indicated distinct progress in reorganizing their work to meet the new conditions and needs.—*Experiment Station Record.*

SCIENTIFIC BOOKS

DARWIN AND OUR INTELLECTUAL HERITAGE

Darwin, Marx, Wagner. Critique of a Heritage. By JACQUES BARZUN. xii + 420 pp. Little, Brown and Company. 1941. $2.75.

A BOOK about Darwin, Marx and Wagner all at the same time will cause some lifting of eyebrows. The author explains the juxtaposition of names in the first sentence of the preface: "This book has not three subjects, but one. That one is simply the prevailing form of our thinking in an age of materialism and machinery." Darwin, Marx and Wagner were in some way responsible for, or at least have symbolized the advent of, the current ideas in their respective spheres—science, social science and art. "Through their efforts, feelings, beauty, and moral values were shown to be illusions for which the world of fact gave no warrant." And "when the layman carries his thoughts beyond what he can see and touch, mechanistic materialism becomes a menace." The present world catastrophe is the upshot.

The author is neither a biologist nor an anti-evolutionist. He is an outstanding historian and philosopher interested in the development of the intellectual climate of our time. Asking Professor Barzun's forgiveness, we shall consider only the part of his book dealing with Darwin. To many a biologist his treatment of Darwin will seem irreverent to the point of blasphemy. But the author's arguments can not be shrugged off so easily. Darwin's theory of evolution has gained a general acceptance, while theories of his predecessors had failed to do so. We have been taught that the cause of Darwin's success lies in the mass of evidence carefully marshalled by Darwin in support of his views. The author does not deny this explanation. However, he points out that the intellectual *tastes* of Darwin's *age* were peculiarly favorable for adoption of just that kind of a theory. "To scientists and laymen alike, the appeal of natural selection was manifold. It had the persuasiveness of 'small doses'; it was entirely automatic, doing away with both the religious will of a creator and the Lamarckian will of his creatures; it substituted a 'true cause' for the 'metaphysical' sort of explanation; lastly, natural selection was an exact parallel in nature to the kind of individual competition familiar to every one in the social world of man." In a period of imperialistic expansion the theory of natural selection lent itself to misuse to confer a semblance of respectability on dastardly political doctrines. "Darwin did not invent the Machiavellian image that the world is the playground of the lion and the fox, but thousands discovered that he had transformed political science. Their own tendencies to act like lions and foxes thereby became irresistible 'laws of nature' and 'factors of progress,' while moral arguments against them were dubbed 'pre-scientific.'"

It is to be regretted that Professor Barzun did not confine himself solely to historical criticism and could not resist the temptation to judge biological theories on their scientific merits. The theory of natural selection has certainly been debased, but it happens to be, in its modern form, a description of a well-established agent of evolutionary change. It does not require life-and-death utility of the evolutionarily effective variants, it is perfectly compatible with the "orderliness in the facts of heredity and variation," and it is certainly much more than "the right wrong idea" to convince the uninitiated in the truthfulness of the proposition that organic evolution has taken and is taking place. No references to authorities, however well chosen, can discredit natural selection in its proper sphere. In the reviewer's opinion the author's emphasis on the fact that Darwin was by no means the first evolutionist, and that he has, probably unconsciously, used certain ideas of his predecessors without proper acknowledgment, hardly detracts much from Darwin's stature as a scientist. After all is said and done, it is Darwin who has advanced the first evolution theory which has on the whole withstood the experimental tests imposed on it and which has developed into the modern edifice. True, it has changed greatly in the process, but so has physics since the times of Galileo and Newton.

The usefulness of the book of Professor Barzun stems from the fact that, as he correctly remarks, "science is not only man-made but man-used." Neither a biologist nor a layman can be disinterested in the uses to which the product of the scientific work is put. In this realm the evaluation can best be made by a historian. The brilliantly written and thought-provoking book of Professor Barzun will certainly repay a careful reading and contemplation.

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SPECIAL ARTICLES

GROWTH STIMULATION BY SULFANILAMIDE IN LOW CONCENTRATION

THE bacteriologist is well acquainted with the growth-stimulating effect of toxic materials in low concentration. Probably the best-known substances in this respect are the toxic cations on which extensive exact quantitative studies have been made.[1] But a wide variety of dissimilar substances have been noted to show the same stimulative action. Fred[2] has recorded observations on ether and salvarsan. Rahn[3] quotes Hofmann, who studied the phenomenon for lysol, atropin, saponin, malichite green, etc. More recently Beckwith and Geary have reported on indol-3-acetic acid.[4] There are a great number of other published observations.

Inasmuch as no such work has been reported in connection with sulfanilamide or other therapeutically significant sulfa drugs a study of sulfanilamide was undertaken.[4a] A qualitative method, the agar cup plate technic,[5] was employed. In addition some tests were run by placing either 5-grain or 7.5-grain sulfanilamide tablets in the center of a sterile petri plate and pouring agar inoculated with a milliliter of an 18-hour broth culture of bacteria or 48-hour broth culture of yeast. Depending on the organism, the tablet or agar cup filled with sulfanilamide was surrounded by a zone of no growth or partial growth. At the edge of the area of inhibited growth stimulation was indicated by the appearance of a zone of growth heavier than elsewhere in the plate. Control plates were poured to check the distribution of inoculum in the agar and the possible influence of technique. For the bacteria, a beef infusion to which was added 2 per cent. sodium chloride, 1 per cent. Difco-peptone and 0.05 per cent. glucose was used. This was adjusted to pH 7.6. Czepak's medium was employed for the yeasts studied.

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[1] Margaret Hotchkiss, *Jour. Bact.*, 8: 141, 1923.

[2] E. B. Fred, *Zentralbl. f. Bakt.* (abt. 2), 31: 185, 1912.

[3] O. Rahn, *Physiology of Bacteria*, 1932, Blakiston, Philadelphia.

[4] T. D. Beckwith and E. M. Geary, *Jour. Inf. Dis.*, 66: 78, 1940.

[4a] Since submitting this paper a study has appeared (SCIENCE, 95: 104, 1942) by H. A. Johnson reporting stimulative action on luminous bacteria. The present data can be interpreted to support Johnson's hypothesis that sulfa-drug action is related to general theories of

The following bacteria from our stock culture collection showed no zone of stimulation: *Lactobacillus acidophilus, Streptococcus fecalis, S. zymogenes* (both a proteolytic and non-proteolytic strain), *S. durans, S. mastiditis, S. pyogenes group A* (strains Dochez, J 17A4), two strains of *S. lactis, Escherichia coli, Aerobacter cloacae, Salmonella schottmulleri, S. paratyphi, Shigella gallinarum, Klebsiella ozaenae, Staphylococcus citreus, S. albus, Sarcina ventriculi, Micrococcus nitrificans.* Irregular results were given by *Aerobacter aerogenes* and two strains of *Eberthella typhi.*

Stimulation was exhibited by a strain of *Pseudomonas aeruginosae* and *Alkaligenes fecalis.*

Of 29 strains of aerobic spore-forming bacteria tested, 12 which represented strains of *Bacillus vulgatus, B. mesentericus* and *B. mycoides*, showed zones of stimulation. Gram stains prepared from cells in the stimulation zone and from normal growth revealed no obvious or systematic differences. In one case cells from the stimulation zone showed a greater number of chain formations. In another case the cells were larger.

Of 12 strains of *Bacillus vulgatus* (identified according to published criteria[6]) 7 showed a zone of stimulation. Thus the effect seems to be an intraspecies one rather than related to the species.

The zone of stimulation did not always appear in the early stages of growth. Often it became visible only after 72 hours of growth.

In the case of the yeasts, an unidentified strain of *Torulaspora* showed a zone of slight stimulation. The following were not stimulated: *Torula glutinis, T. cremoris, Saccharomyces cerevisiae, S. ellipsoideus, Willia anomala, Zygosaccharomyces bailii, Oidium lactis, Monilia nigra.* The yeasts were incubated at room temperature and observed at the end of 72 hours and 7 days.

Will an organism manifest stimulation by one toxic substance and not another? Apparently it will, as tests run on *Escherichia coli, Bacillus subtilis, Willia anomala* and a few others gave a stimulation zone with bichloride of mercury and not with sulfanilamide.

Of late there has been renewed interest in the therapeutic efficacy of anti-bacterial substances produced by microorganisms. It would be informative to know whether they too exhibit a stimulative action in low concentrations. Waksman[7] in a review of the subject of bacterial antagonism makes no mention that the question has been considered. Yet it is evident that for one of these substances, actinomycin, a stimulative effect is exerted on *Bacillus mycoides* and *Sarcina lutea* as photos published in a paper[8] describing *Actinomyces antibioticus* clearly show zones of stimulation.

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INCREASED LIVER ARGINASE ON ADMINISTRATION OF ADRENOCORTICAL AND CORTICOTROPIC HORMONES[1]

IT has been shown in recent years that dietary conditions may affect the arginase content of the liver of rats. Thus, as would perhaps be expected, factors leading to increased deamination and gluconeogenesis, such as high protein diets or fasting, were found to increase liver arginase.[2] An investigation of the action on liver arginase of hormones known to control the rate of gluconeogenesis appeared indicated.

Liver arginase was determined in several groups of hypophysectomized rats which had received 15 daily injections of pituitary extracts high in adrenocorticotropic activity (ACT H),[3] and in one group which had been similarly treated with cortin (Adrenal Cortical Extract, Upjohn).[4] In each case a considerable

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narcosis, and possibly bring some of the biologically produced antagonistic substances within the ken of narcotic mechanisms.

[5] U. S. Department of Agriculture Circular No. 198, 1931.

[6] C. Lamanna, *Jour. Inf. Dis.*, 67: 193, 1940.

[7] S. A. Waksman, *Bact. Rev.*, 5: 231, 1941.

[8] S. A. Waksman and H. B. Woodruff, *Jour. Bact.*, 42: 231 (fig. 1), 1941.

[1] Aided by grants from the Board of Research of the University of California and the Rockefeller Foundation, New York City, and Parke Davis and Company, Detroit, Michigan. We wish to acknowledge assistance from the Work Projects Administration, Project No. OP-65-1-08, Unit A-5.

[2] D. H. Lightbody and A. Kleinman, *Jour. Biol. Chem.*, 129: 71, 1939; *Proc. Soc. Exp. Biol. and Med.*, 45: 25, 1940.

[3] Prepared according to an as yet unpublished method of C. H. Li, of this laboratory.

[4] The determination and the calculation of arginase unitage were performed according to Edlbacher (S. Edlbacher and H. Röthler, *Zeits. physiol. chem.* (Hoppe-

increase in the arginase content of the livers of the treated rats was evident (see Table I). In a few groups, liver arginase was determined after treatment with the same dose of ACT H in combination with lactogenic hormone; also after the same cortin treatment, combined with growth hormone. In each case increases were found, but these were somewhat less pronounced than those brought about by ACT H or cortin alone. Studies of the effect of various other purified pituitary hormones and of thyroxin are in progress. As was noted by Lightbody,[5] we find the hyperthyroid state, produced by high doses of thyroxin in normal rats, to be associated with a tendency to increases in liver arginase; physiological doses of thyroxin in hypophysectomized rats seem to have the opposite effect.

TABLE I

*Effect of Adrenocorticotropic Hormone (ACT H) and of Cortin on Liver Arginase of Hypophysectomized Rats**

Exp. No.	Treatment	Liver Arginase Content		
		per g Liver (Units)	per 100 g Rat	
			(Units)	Increase Per cent.
1	ACT H treated	2,700	8,400	+ 75
	controls	1,675	4,800	
2	ACT H treated	2,350	8,450	+ 220
	controls	800	2,640	
3	ACT H treated	2,000	7,200	+ 82
	controls	1,200	3,900	
4	Cortin treated	2,550	7,900	+ 193
	controls	925	2,700	

* All fasted 21 to 24 hours preceding autopsy, after an injection period of 15 days. Treated rats in expts. 1 to 3 received 3.9 mg of the hormone preparation daily and three times during the 24 hour fast. Rats in expt. 4 received 0.5 cc of Upjohn's Adrenal Cortical Extract twice daily, with three injections of 1 cc during the 24 hour fast. The rats in expts. 1 to 3 were males, approximately 50 days old at operation and injected from the first day p.o. on. Those of expt. 4 were females, operated when approximately 30 days and injected after a postoperative period of 1 to 2 weeks.

The ACT H preparation used contained about 5 to 10 per cent. lactogenic hormone and less than 1 per cent. of other known hormones. The adrenal weights of the treated animals average 51 mg, those of the controls 14 mg.

The striking increases in liver arginase produced by pituitary adrenocorticotropic preparations, as well as by an adrenal cortical extract, are in good agreement with the theory that the adrenal cortex plays a predominant role in the hormonal control of gluconeogenesis. It has been established through the work of Long[6] and others, that certain hormones of the adrenal cortex enable fasting animals to maintain or even increase their carbohydrate stores, at the expense of body proteins; a similar action of ACT H has been demonstrated by Bennet[7] and has since been amply confirmed by us. It is obvious that the action of these hormones in increasing liver arginase would favor gluconeogenesis.[8]

Studies are under way as to the effect on liver arginase of purified pituitary hormones under varied conditions in normal and hypophysectomized rats. The liver arginase increasing activity of various pure adrenocortical steroids should also be tested.

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THE EFFECT OF A PREPARATION OF AMINE OXIDASE ON EXPERIMENTAL HYPERTENSION

There is evidence that deamination but not decarboxylation of certain amino acids is incomplete in kidneys deficient in their supply of oxygen.[1,2] Since decarboxylation of amino acids leads in many instances to the formation of pressor amines, it was believed that this process might be responsible for some varieties of arterial hypertension. Because the enzyme tyrosinase lowers the blood pressure of hypertensive animals and human beings,[3,4] a phenolic compound is probably concerned in the existence of this condition. It was desirable that other enzymes with known activity be employed in arterial hypertension in order that something further be learned regarding the nature of the pressor substance or substances.

A preparation of hog liver containing active amine oxidase, an enzyme specific for certain amines,[5] was, therefore, given to animals. The intravenous injection of a small amount of this material consistently lowered the blood pressure of hypertensive rats, affecting that of normal ones to a less extent. When this preparation was mixed with a solution of angiotonin or tyramine the pressor response of these substances was abolished. Rats which had been injected

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Seyler), 148: 264, 1925) and Takehara (H. Takehara, *Jour. Biochem.* (Tokyo), 28: 309, 1938), using xanthydrol for urea determinations. Since no activator was added to the crude liver extracts the determinations are regarded as indicating the amount of naturally activated arginase only. All rats were fasted 21 to 24 hours preceding autopsy.

[5] D. H. Lightbody, E. Witt and A. Kleinman, *Proc. Soc. Exp. Biol. and Med.*, 46: 472, 1941.

[6] C. N. H. Long, B. Katzin and E. G. Fry, *Endocrinology*, 26: 309, 1940.

[7] L. L. Bennet, *Proc. Soc. Exp. Biol. and Med.*, 37: 50, 1937.

[8] Liver and muscle glycogen and blood sugar were determined in all rats included in the table; nitrogen excretion during the 24-hour fasting period was determined in experiment 1. While these results will be presented elsewhere, it should be stated that they indicated a definitely increased rate of gluconeogenesis in the treated animals.

[1] P. Holtz, K. Credner and H. Walter, *Zeits. physiol. Chem.*, 262: 111, 1939.

[2] R. A. Bing, *Am. Jour. Physiol.*, 132: 497, 1941.

[3] H. A. Schroeder and M. K. Adams, *Jour. Exp. Med.*, 73, 531, 1941.

[4] H. A. Schroeder, Science, 93: 116, 1941.

[5] H. Blaschko, D. Richter and H. Schlossman, *Biochem. Jour.*, 31: 2187, 1937.

with the enzyme were partially or totally refractory to the pressor action of renin.

The material (liver extract) was then injected intravenously in daily doses into five dogs made hypertensive by the Goldblatt[6] technique. The blood pressure of all fell to normal levels within three to five days. The blood pressure of five normal dogs was similarly affected, but less. Associated with the fall was a reduction in the amount of urea nitrogen in the blood. A return to previous levels occurred a few days after the injections were stopped; when it was resumed the changes were repeated. In two hypertensive dogs the blood pressure and urea nitrogen both fell, but giving, subsequently, larger doses resulted in a further fall in blood pressure, a rapid rise in urea nitrogen, and death from uremia. Subcutaneous injections of this substance were followed by similar changes, but abscesses occurred. It was for that reason impossible to estimate the nature of the effect on hypertension. Larger quantities of the material given by mouth had little or no effect in three dogs and one monkey. The changes observed did not result from the action of non-specific proteins; aliquot amounts of horse serum and ten preparations of inactivated enzyme, given daily, did not affect blood pressure.

The preparation appeared to be somewhat toxic to anesthetized rats, but did not adversely affect unanesthetized dogs. The material was insoluble and the enzyme unstable. It did not oxidize phenols. As many impurities were present it can not be concluded that the results were due to the action of amine oxidase, but this interpretation is possible. If so, amines are concerned in this type of hypertension.

Note: The author is indebted to Merck and Co., for supplying the preparation of amine oxidase.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF BROMOFORM IN THE SEPARATION OF NONCALCAREOUS MICROFOSSILS

Pollen grains, plant spores, diatoms, sponge spicules and other microfossils are much more commonly present in unconsolidated sediments of Cenozoic age than has ordinarily been assumed. If properly identified, the microfauna and microflora of such deposits may prove to have great value in correlation and in studies dealing with the climatic and other conditions at the time and place of deposition. The separation of foraminifera and other calcareous microfossils from sediments by means of heavy liquids such as bromoform has become standard practice in many petrographical studies.[1] The value of such methods for the separation of the non-calcareous microfossils has not, however, been generally recognized.

During the last few years the writer[2] has been using a bromoform-acetone solution of a standard specific gravity to separate such fossils from various types of unconsolidated sediments ranging in age from Cretaceous to Recent. The technique that has been developed has led to the discovery of fossils in sediments that have formerly been considered to be completely barren. The method of separation and concentration is simple, rapid and complete. The microfossils of various types are concentrated together, thus making possible quantitative studies of the different elements of the fauna and flora. The method is applicable to most types of microfossils found in sediments, including foraminifera, ostracods (with the two valves in place), radiolaria, silicoflagellates, siliceous sponge spicules, diatoms, pollen and spores of plants, and the light remains of plants and animals, which are often of diagnostic value. The method is especially valuable when dealing with sediments containing relatively few individuals.

The skeletal remains of most diatoms, radiolaria and silicisponges are composed of colloidal silica in the form of opal with a specific gravity of 1.9–2.3. Since quartz and the common clay minerals of which most sediments are composed have a somewhat higher density (2.5–2.7), it is possible to separate these siliceous fossils from unconsolidated sediments by means of a heavy liquid with a specific gravity of 2.3. Although the writer has found no previous reference to the use of heavy liquids in separating sponge spicules, radiolaria and silicoflagellates from sediments, he has found that the method has been occasionally used for the concentration of diatoms. Such a method is described by F. Hustedt.[3] In this case Thoulet solution with a specific gravity of 2.3 was employed. This solution, however, is extremely poisonous and because of its corrosive properties and the difficulties involved in its use, it is not as suitable as bromoform.

Sediments also frequently contain small numbers of pollen grains and spores. These are customarily concentrated by using hydrofluoric acid, which dissolves out the silica and leaves the plant residue in a great enough concentration to facilitate pollen counts.[4] This concentration can be accomplished more efficiently and with less danger by using bromoform and acetone with a gravity of 2.3. Although pollen grains may be separated by means of a liquid of a lower density, experience has shown that with a high gravity solution there is less chance of loss, because there is less rapid settling of the sediment. Recently V. P. Grichuk[5] described a similar method for recovering pollen from loess deposits. The liquid used was "Toulé" (Thoulet?) solution with a specific gravity of 2.2.

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[6] H. Goldblatt, Harvey Lectures, 33: 237, 1937–1938.

[1] Marcus A. Hanna, *Econ. Geol.*, 22: 1, 14–17, 1927.

[2] Acknowledgment is gratefully expressed for financial aid received from Mr. Robert W. Sayles and the associates in science of Harvard University.

[3] F. Hustedt, "Die Kieselalgen Deutschlands, Österreichs und der Schweiz" in Rabenhorst, L., *Kryptogamen-Flora von Deutschland, Österreich und der Schweiz.* Vol. vii, pp. 189–190, 1927.

The following is a description of the method that has been employed by the writer in examining various types of sand, silt, clay and till for microfossils. The method can be easily modified and can be used in conjunction with other methods commonly employed, when a greater concentration or a thorough cleaning of the microfossils to be studied is desired.

The unconsolidated sediment must first be completely broken up into its constituent parts and thoroughly deflocculated so that the fossils may be as free as possible from adhering material. With the coarser sediments this can usually be done by shaking the dried sediments in the bromoform to be used for the final separation of the microfossils, until the particles are entirely separated. With finer sediments, such as silt and clay, other methods are usually necessary. Ordinarily these sediments can be easily broken up by soaking small pieces of the material in water or in acetone followed by repeated agitation. If the sediments can not be broken up in this way, it becomes necessary to use alkalies or acids, although such means should not be used unless absolutely necessary because of the danger of destruction of some of the microfossils.

After the material is broken up and washed in acetone, it is thoroughly dried and then placed in a mixture of bromoform and acetone with a specific gravity of 2.3. After thorough mixing with the heavy liquid it is centrifuged. The light portion containing the fossils, which is found floating on the surface of the liquid, is poured off, filtered, washed thoroughly in acetone and dried over a hot plate. In most cases it is desirable to centrifuge the sediments several times in order to get a complete separation, especially when quantitative studies are being made. For preliminary work, however, it is generally necessary to centrifuge them only once. The dried material is then examined for fossils, and if present they are mounted directly or further concentrated and cleaned by methods commonly employed in the study of the different types of microfossils.

The bromoform may be recovered from the acetone washings and used again. This is done by mixing the washings in water and separating the bromoform from the water and acetone by means of a separatory funnel. It should be pointed out that bromoform is somewhat poisonous, but if it is used in a well-ventilated room or under a ventilating hood, there is no danger of unfortunate effects.

The method described above should be of considerable value to those engaged in ecological studies of modern lake sediments and deep-sea deposits as well as in many geological investigations involving the use of microfossils.

ARTHUR S. KNOX

GEOLOGICAL MUSEUM,
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HIGHER LEVELS OF INTEGRATION[1]

By Dr. R. W. GERARD

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OF the several integrating mechanisms which convert a cell population into a multicellular individual, that of transmission is mainly responsible for the differences between "higher" and "lower" organisms. As it has improved, so has adaptive amplification, the ability of an individual to respond to environmental events, including those related to other individuals. This paper will be concerned, consequently, with the evolution of transmissive mechanisms and with the unit-whole relations which they serve—between cells in the organism and between organisms in the social group.

TRANSMISSION

Protoplasm, subjected to an adequate stimulus, enters a new and often specific state; it gives its characteristic response—a muscle twitches, a gland secretes. But the response is not restricted to the stimulated region: the urchin egg starts to lift its membrane where the sperm enters, but this continues to rise around the whole egg; the end portion of a muscle fiber, far from the point of nerve entry, participates in the general shortening. Something, some form of excitation, must be propagated or communicated from the originally excited region to neighboring ones; and this is the essence of transmission. This universal capacity of protoplasm to hand on excitation is developed into an exquisite talent by the nerve cells, once they appear. Along their fantastically extended straight processes the nerve impulses, propagated excitation waves, rush to various destinations.

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[1] From an address at the University of Chicago Fiftieth Anniversary Celebration. The complete paper will appear in Biological Symposia, Vol. 8.

Evolution exhibits striking directional changes in the transmissive capacities of organisms. In speed, for example. The egg membrane rise crawls at the rate of a centimeter an hour; in the adult sponge a message goes that distance in a minute. With the appearance and improvement of a nervous system rates jump precipitously—to 10 cm a second in the net-like nervous system of the jellyfish bell, to a meter a second in the longitudinally directed nervous system of the worm, and to ten and a hundred times this speed in the nerve fibers of arthropods and finally of vertebrates. Or in distance. Excitation in the sponge dies out in a centimeter or two, but neural transmission is unlimited since the impulse retains full intensity as it travels. Or in pattern. Transmission is diffuse in the egg or sponge and essentially so along the interlacing nerve cells of the jellyfish. But in the worm, with nerve cells grouped at each segment, most stimuli elicit local reflexes, and behavior is largely segmental and highly stereotyped in terms of fixed nerve connections.

Vertebrates have elaborated these segmental channels but have added control by functional state, have superposed dynamic patterns on structural ones, and have greatly enhanced the modifiable and integrative aspects of behavior. Such attributes are particularly related to the suprasegmental brain, mainly the cerebral cortex, which originates in the reptiles, flowers in the mammals and culminates in man. The cerebrum dominates the brain stem mechanisms and introduces latitude in the type and timing of total response to a fixed stimulus. It permits that gradual shift in behavior with accumulated experience, which we call learning; and when sufficiently developed, as in man, it permits abstraction and the direction of action by language and other symbols.

The nervous system adjusts an animal to its environment; the environment, reciprocally, has fostered the development of the nervous system. The front end of a moving animal receives most stimuli. There sense organs become more sensitive—to feebler and more variegated and more distant changes—and from them an ever increasing rain of impulses pours into the primitive brain. There the raw sensory data must be coordinated if a unified behavior is to ensue, and there the continued lash of excitation somehow led to the great overgrowth of the cerebrum—from the original nervous center for smell, the first "distance" sense. The environment dominates the receptors and these the brain as this dominates the spinal cord or the nervous system the entire body. A higher organism, then, has advanced beyond a lower one in its ability to respond to more kinds and gradations of environmental change with behavior which is more rapid, complex, variable, integrated and especially, adaptive.

The anatomy and physiology of the nervous system have psychological correlates. The automatic segmental portion is dedicated to self-preservation, and the awareness attending its functioning is unthought affect or feeling. This is evoked almost routinely by particular stimuli and serves individual concerns. It is the selfish part of the psyche. Cerebral awareness is more abstract and represents the reasoning, valuing, aspiring part of consciousness. It is the social part of the psyche which transcends the immediate and selfish and makes group living possible. Injury to or removal of the cerebrum impairs or abolishes the unselfish care which the mammalian mother gives, often at her own sacrifice, to her young and so to her race; but it merely exaggerates the aggressive competitive behavior, seen so clearly in the battles between males for possession of a herd.

It is important that suprasegmental function is gaining still over segmental function, if not by anatomical growth at least by physiological exercise—via education and the swelling base of knowledge. And with this must come a relative increase of altruism over selfishness with continued biological or social evolution. Indeed this is seen at all levels of the living world, for with evolutionary advance there is progressive emphasis on cooperation of unlike units relative to competition between like ones. Both elements are always present, in a cell's protoplasm as in a human's nature; but a step towards differentiation of units and their reintegration into a cooperating whole has always been retained—presumably because it has survival value. This is equally clear for the special organelles of cells, the special cells and tissues of many-celled individuals, and the special individuals of colonies or social groups.

PART AND WHOLE

A unit system composed of lesser units in some degree of interrelation, in contrast to a mere unrelated assemblage, is an organism in the broad sense. To avoid confusion with animate organisms, this has been called an org, and the subclass of living systems, animorgs. Orgs differ in degree of integration and level of organization. As integration increases the control of the units by the org becomes relatively greater—as in passing from molecules in a gas, to a liquid, to a surface film; and the units commonly show greater differentiation—surface molecules become different (often permanently so) from others. An org at one level may, in turn, be a unit in an org of higher level—molecules in cells, cells in multicellular organisms. The degree of integration is determined by the relations between penultimate units and whole—a sponge is a poorly integrated org at the multicellular level, although its cells are highly integrated orgs at the cellular level.

Animorgs are distinguished by several criteria: they possess a structure based on carbon and water, on colloids and membranes; they show a continuous change with time, development of the individual or the type; they manifest the same activities of dynamic equilibrium (roughly metabolism), specific synthesis (roughly growth), and adaptive amplification (roughly behavior); and they are integrated by the same gradient, mechanical, transportative and transmissive coordinating mechanisms.

The panorama of evolution shows a strong tendency for animorgs, indeed for orgs in general, to evolve towards increasing integration at any one level and to superpose additional levels of complexity. Thus, at the subcellular level molecular orgs increase in integration until autocatalytic and virus molecules appear. The cellular level is then added, with molecules (including autocatalytic ones) as units, and at this new level integration again advances from that of the simplest micrococci to that of the most elaborate flagellates. Another level, of multicellularity, is then added and metazoans increase in integration and complexity from the sponge through man. There is no obvious reason why the multicellular individual should remain the highest level of evolutionary invention, and in fact it does not.

Multicellular organisms are as clearly built into higher level animorgs, which may be called epiorganisms, as are cell animorgs built into multicellular ones. The colonial coelenterates become that striking individual epiorganism, a Portuguese man-of-war, in the extreme case; the social insects evolve from the most crude and temporary groups into the highly characteristic epiorganism of the single beehive or anthill or termite nest. The physiological structure of a particular termite colony and the physical characteristics of its nest are as unique for each species as are the attributes of the individual insects; yet the nest is the collective achievement of the group and quite beyond the capacities or level of the individual. In the same way, the mammalian family and herd and ultimately the larger human social groups constitute various epiorganisms. These are poorly integrated at the epiorganismic level and such units as a single nomad tribe, the British Empire, the human race and the entire ecological community may be chosen as overlapping examples of human epiorganisms.

Such groups of organisms form a true unit, albeit often a poorly integrated one, and it is an animorg by all the defining criteria—composition, development, activities and integrating mechanisms. Consider, for example, just the question of transmission, since the whole material has been presented elsewhere.

Transmission is called communication in the society and is mediated largely through the seen or heard symbol which is the analogue of the propagated protoplasmic or nerve impulse. Our symbols, our language, correspond still to the graded transmission of undifferentiated protoplasm, rather than to the sharply all-or-none messages carried by nerves; but these are also evolving and their precision is being enhanced with the aid of semantic and semiotic disciplines. Also in the evolving epiorganism, as in the organism, the speed and distance of effective transmission steadily increases, and the units particularly responsible for communication become centralized—we need glance no further than the great newspaper and radio chains. Finally, the driving evolutionary factor in the case of the epiorganism, as of the organism, is the stimulating action upon it of its environment. External stimuli lead to high specialization of receptors which receive them, and the receptors in turn become the dominant elements in the organismic gradient and so lead its development. The social receptors which continually expand their sensitivity to the outer world are the scientists, and these units now point the direction of social evolution. All agree that this is the "age of science," whether they like it or not.

Of the many objections to the organismic view of society, two have been especially urged: (1) coherence of the social group depends largely in inanimate materials, and (2) the component units are spatially separate and independently mobile individuals.

As regards the first, it may suffice to point out that in the organism, likewise, much of the body material and structure is clearly dead, although laid down under the influence of living cells. It is even true that special types of non-living material become increasingly important as multicellularity appears and develops. Thus the wood walls and tubes of the higher plants are completely dead yet highly serviceable to the organism; as are the calcareous or chitinous skeletal structures of many animals. Our own outer skin and nails and hair, most of our bone and cartilage, the great masses of connective tissue fibers which support and give cohesion to our tissue cells and our body fluids, including the great fluid fractions of lymph and blood, are all completely dead. They have been built or accumulated by the action of living cells, but are not themselves alive and in many cases never were. Wood, bone, chitin, sclero-proteins have been overwhelmingly invented or applied by the multicellular organisms. In the same way, not solitary but social man has introduced as new structural materials in the body of his epiorganism such substances as cement, rubber, plastics and metals.

As for the second point, the separation and mobility of the units, similar parallels can be seen in the animal body, as in the wandering digestive cells of invertebrates. But an especially beautiful case is at hand in the slime molds studied by Raper. Through the entire period of vegetative life, the many single amoeba-like cells pursue their independent ways, seemingly an uncoordinated aggregate of separate individuals. Yet when food fails the myxamoebae stream together to form a characteristic ensheathed worm-shaped mass. This has a dominant head end which leads the rather considerable migration of the whole and which finally becomes a particular region of a sporebearing fruiting body. This latter is a morphologically and physiologically distinctive multicellular organism. In the same way, individual men may seem to pursue their "independent" courses (yet far more interdependent than are the vegetative myxamoebae) under "normal conditions"; yet they also promptly manifest their character as units in a greater whole when conditions demand. In the supreme emergency of warfare, the overt integration into a greater whole, the army, is almost as complete as in the ordinary multicellular organism, with the units often in close physical contact and with independent mobility largely abrogated.

MAN AND SOCIETY

Man then is an org, an individual organism, and he is part of an org, a unit in an epiorganism. Many of the problems and conflicts in human nature and in social relations seem to stem from this fundamental duality. As societies develop there is an indubitable trend towards greater cohesion—in the so-called democracies only less than in the avowed totalitarian states. (Reasons for not equating this trend with Naziism or any other existing dictatorship are developed elsewhere.)

Societies evolve into more integrated orgs and the parts, down to individual man, become more subordinated to the larger group. As the royal government overcame and absorbed those of the petty nobles, so our federal government is inevitably growing relative to state governments; and it is not a question of if, but only of when, an effective international unit will supplement, and eventually largely supplant, our present national ones. Isolationism is a biological anachronism.

The individual is also, of course, changing under the influence of the epiorganism in which he develops; and he both gains and loses freedoms. Social man has lost the freedom to run naked in summer, but has acquired the freedom of turning on the furnace in winter; he has lost the freedom to kill his fellows, but has acquired the enormous freedom conferred by a language with which he can discuss disagreements. There is no question that we prefer the new freedoms gained to the old ones surrendered. The important point is that healthy evolution brings about these changes by subordination, not by suppression. The individuals are imperceptibly conditioned to their social mileu, the internal environment of the epiorganism, and overwhelmingly they behave as they do with no feeling of coercion but rather with one of free and voluntary action.

Perhaps the most significant of these gradual changes in individual men, considered collectively, is the progressive growth of altruism. Altruism at the social level is a manifestation of the same cooperative actions which are present always between the units of an org and which are enhanced by evolution at each biological level. As single cells with differentiated cooperating protoplasmic structures have appeared and prospered in the course of evolution; as multicellular organisms have steadily moved towards more specialized and interdependent parts and organ systems; as the mother cares for and sacrifices in behalf of the young in the family org, and the individual member of many a subhuman group helps and sacrifices for his fellows under an impressive variety of conditions; so in humans individual loyalty towards and service or sacrifice in behalf of the group—trade or professional organization, religious body, and particularly the whole state—is marked and is increasing.

There are, however, serious transitional problems which may well become worse before being resolved. They arise peculiarly, I think, from the existence of very highly integrated units in a still very poorly integrated org. The amount of physical power wielded by the society, and the differentiation of its unit members into highly developed specialists of all kinds, have increased faster than have those coordinating mechanisms which must effectively reintegrate these units into the whole. (This one might regard as a consequence of the earlier and more lusty growth of the physical sciences as compared with their social counterparts; and it is a healthy sign that to-day so much constructive thought and support are being given to the development of the latter.)

Society, for example, is in bitter need of better mechanisms for selecting its leaders, the individuals who will play the dominant role in the social gradient, as the brain and receptor cells exercise physiological leadership in our own bodies. When proper leaders—men qualified by talent and training for the duties demanded in the position of social leadership—can be selected by devices which are more dependable and objective than are the accidents of family, rhetoric, ambition and other circumstances which to-day frequently toss undesirable individuals to the apex of the power pyramid, I believe that the most serious of the world's afflictions will have been conquered. The social mechanisms of integration are continuously evolving by invention and the pressure of necessity. They will be tested and will endure or be superseded on the same criteria of fitness for survival that have led, through natural selection, to the highly adapted multicellular organisms.

Man as an org is selfish, individualistic and dominated often by the old brain and its emotional attributes. Man as a unit in the epiorganism is altruistic, cooperative, and depends on the functioning of his new brain and its intellectual attributes. But the subordination of the old by the new is not yet sufficient. Human nature is evolving but is doing so less rapidly than is the epiorganism in which it expresses itself. Altruism is not yet generalized to the full group, to the whole human epiorganism, but only to the larger subordinate groups based on race or religion or state. As the units given adherence have grown, so have the conflicts between these units become more massive and devastating; and perhaps still other wars on a still greater scale are to be encountered on the path to world integration. But ultimately this integration must be achieved and conflicts of the present type become impossible.

The new brain, the cerebral cortex, is evolving continuously and greatly under the influence of education, which profits by cumulative social achievement; the world is ever more at our individual doors, and cooperation is being generalized to larger and larger groups; mankind as a whole will become an integrated cooperative unit; and the ultimate future of human society, however dark it may look to the contemporary sociologist or even to the historian, appears in the eyes of the biologist, sighting down the long perspective of organic evolution, as bright with hope.

HOW PLANT BREEDING PROGRAMS COMPLICATE PLANT DISEASE PROBLEMS

By Dr. NEIL E. STEVENS

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THE present interest in breeding crop plants, together with present means of wide and prompt dissemination of new varieties bids fair to still further complicate disease problems, whether of control, prediction or even of estimation. Given a fairly stable agriculture based on varieties long established in a region, serious fluctuations in the severity of a disease, the kind which are of great economic importance and incidentally of much scientific interest, usually were induced in one of two ways—a marked change in the weather for a longer or shorter period, or the appearance, by hybridization or mutation or by actual introduction, of a new parasite. So generally has this been the case that some pathologists have found an apparent relation between the age of an agriculture and the losses from plant disease. To these students it has seemed that plant disease losses were greater in the regions of newer agriculture.

The list of tragic losses in important economic plants due to introduced insect pests and plant diseases is a long one, too well known to need repetition here. Of the converse process, a serious outbreak of a disease or an insect pest following the introduction of a susceptible variety into the domain of a potentially serious parasite, the history of the potato beetle is perhaps the best known example.

If the historical accounts are correct, the potato beetle acquired its appetite for potato plants very soon after the introduction of the new host. The corn-borer was apparently more deliberate and according to Wardle,[1] "We have historical evidence that the corn-borer thirty years ago was in southern Germany a pest of hemp and hops, and that since its adaptation to corn, it will not seriously attack hemp and hops, even when these plants are grown in close proximity to heavily infested corn fields." Of course, the slightly more than four centuries during which corn had then been cultivated in Germany is really a short time compared with the more than forty centuries which DeCandolle believes hemp had been cultivated, but it is entirely too long to be regarded as a practicable test or quarantine period.

To these two well-recognized methods by which the incidence of losses due to disease and insect pests is strongly influenced, namely, weather changes and introduction, there is now being added, I believe, a third, the work of the plant breeders. It may be worth while to consider future possibilities on the basis of past performance, the only method yet devised for any intelligent appraisal of the future.

On the basis of past performance we may reasonably expect interesting developments in the distribution of disease-producing organisms. As an example of this may be cited the case of the introduction into the northern states of the nematode which causes summer dwarf of strawberries. In the spring of 1930 strawberry plants of the then new and highly regarded variety, Blakemore, were shipped from a region where this type of strawberry dwarf was common[2] to many points outside its known range. Apparently no complete survey has been made since 1931, but the subsequent careful work of Christie[3] leaves little doubt that the disease then introduced into the eastern shore of Maryland is gradually becoming less abundant.

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[1] R. A. Wardle, "Problems of Applied Biology." 1929.

Now that breeding for disease resistance attracts so much attention, we must expect the introduction and rapid dissemination of varieties very resistant to certain diseases. Examples of this are easily recalled. Since they represent a distinct economic gain and disturb no one but the student of plant diseases, they get much attention elsewhere and require little here.

Two closely related results of breeding programs which seem worth special consideration are the introduction on a commercial scale of varieties very susceptible to certain, sometimes new, diseases and the modifying effect of new varieties on parasites long known to be of commercial importance.

At first sight, to speak of the introduction on a commercial scale of varieties very susceptible to certain diseases may seem like a criticism of our breeding programs, but it is not so intended. I struggled with this problem for several years, and became convinced that with our available knowledge, it simply is not possible to so fully test our new varieties as to offer assurance that some of them will not sooner or later prove very susceptible to some disease. This should not be interpreted as condoning any laxity in tests for disease resistance which, of course, should be conducted with all possible completeness and severity, but the number of potential pests is so great and the conditions under which they might become serious so varied that any all-inclusive test would take so long and require culture under so wide a range of environmental conditions as to be wholly impracticable. Just as the real test of a new model of automobile is the road test in the hands of the first twenty to fifty thousand owners, so the real test of a new variety is its culture in the hands of ten to twenty thousand farmers.

As evidence on this point, I would like to quote from the summary given by Stakman, Christensen and Becker[4] of the experience in the spring wheat area of the United States of America during the last 25 years. These writers say, "During the time of observation at least twenty new varieties of wheat were introduced into the spring wheat area and almost every one brought new disease problems with it, or at least changed the old ones." As specific examples they point out that for many years Haynes, Glyndon and Preston were the wheat varieties commonly grown. Stem rust and bunt were then the only really important diseases. When Marquis replaced these varieties over a wide area bunt no longer played any role and stem rust seemed somewhat less serious, but scab, which earlier did not have any significance, suddenly became predominantly important, since the new variety was much more susceptible to this disease.

Somewhat later Hope and H-44, neither of which is in the opinion of these authors a very good variety, were introduced. These are in general more resistant to most of the harmful diseases of spring wheat than any other varieties now available, and are being extensively used for crossing. However, there appears to be a strong linkage in many of these crosses between rust resistance and susceptibility to black chaff to which Hope and H-44 are much more susceptible than any other spring wheats which have been observed up to that time. Just as the wide-spread planting of Marquis made scab of real economic importance, so the wide-spread planting of Hope and H-44 might make black chaff of real economic importance.

In the same paper these authors review the situation regarding barley and state that the disease problem in the case of this crop has changed repeatedly with the introduction and culture of new varieties. In discussing the varieties Velvet and Glabron, which were introduced in 1926, they say "but after these varieties were generally grown for several years it was observed that they were very susceptible to loose smut and scab (p. 62). This latter disease is dangerous because it not only greatly lessens the yield in the case of an epidemic, but also makes the variety useless for feeding to swine because of its toxicity (p. 63).

What may perhaps be regarded as the converse of the relation just described is the effect on parasite populations resulting from the introduction of new host varieties, varieties which by their popularity replace those previously grown and thus make inevitable the development of certain strains of these parasites previously so rare as to be insignificant or even unknown. Here again the work of Stakman and his associates furnishes a good example. Who can fail to connect the increase in form 56 from 0.2 per cent. of the rust population in 1930 to 30 per cent. of that population in 1934 with the coincident great increase in the planting of Ceres wheat, first released in 1926, to which variety stem rust proved so disastrous in 1935?

In considering future possibilities regarding plant diseases it would be folly to exclude what is in some ways the most significant and far-reaching change in a crop plant in our generation, the very general planting of "hybrid" corn. Unless you live in the corn belt it is difficult to comprehend the speed and extent of the spread of the vogue of hybrid corn. According to Dr. McCall's report to the chief of the Bureau of Plant Industry, 1939, the approximate acreages of hybrid corn were 500,000 in 1935, 1,500,000 in 1936, 3,500,000 in 1937 and 17,000,000 in 1938. In 1939 at least 25,000,000 acres of corn in the corn belt were planted to hybrid seed.[5]

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[2] N. E. Stevens and P. V. Mook, *Jour. Econ. Entomology*, 25: 447-454, 1932.

[3] J. R. Christie, *Jour. Agric. Res.*, 57: 73-80, 1938 (and earlier papers therein cited).

[4] E. C. Stakman, J. J. Christensen and Hanna Becker, *Der Zuchter*, 10: 57-68, 1938.

It seems hardly possible that so profound a change can be made without altering the disease relations of the crop. This replacing of open-pollinated corn with hybrid corn fits into the problem we have under consideration in at least three ways. First, in the matter of introducing new varieties very susceptible to certain diseases. If any one imagines that the new varieties, or at least new numbers, of hybrid corn introduced into the corn belt during 1939 and 1940 were so thoroughly tested that their disease relations could be predicted, his knowledge of human nature is even more limited than his knowledge of corn diseases. Nor need we wait for the distant future or for the action of unknown diseases on untested hybrids for evidence of extreme susceptibility. Witness, for example, the havoc worked in Hybrid 960 during 1938 by bacterial wilt and Diplodia stalk rot.

Two of the most experienced entomologists in the Middle West assure me that a somewhat similar condition has been noted with relation to at least one insect. According to these observers, the corn leaf aphid, *Aphis maidis* Fitch, was of relatively minor economic importance for many years prior to the introduction of hybrid corn. During recent years, however, with the introduction of a number of very susceptible hybrids the importance of this insect has greatly increased.

What about the effect of hybrid corn on corn parasites? The change in wheat rust in response to the change in the host population was made possible by the variation continually going on in the stem rust organism itself. Corn parasites vary too, some of them, no doubt, even more actively than in any wheat parasites. That the organism which causes bacterial wilt of corn is made up of a large number of strains, among which there is definite selection on repeated passage through a resistant host, has been proved by McNew[6] and by Lincoln.[7] McNew has further shown that slightly virulent cultures become more virulent after they have grown on certain media.[8]

Just how different the host environment of the wilt organism is in the northeastern sweet-corn-growing states from its environment in the same region ten years ago can be understood only if we review the history of Golden Cross Bantam. This is a single cross made up of two inbred lines, Purdue 39 and Purdue 51. In 1931 seed of this extraordinary hybrid, developed by Glenn M. Smith, was distributed to 61 interested growers in 20 states. Its progress since that time may be best traced from the details in Table 1.

Year	Golden Cross bantam seed produced in pounds	Yellow corn canned		Proportion of all sweet corn hybrids used for canning which were Golden Cross Bantam Per cent.
		Open pollinated Per cent.	Hybrid Per cent.	
1932 ..	2,000	..	..	..
1933 ..	350,000	69	31	..
1934 ..	600,000	57	43	67
1935 ..	1,250,000	38	62	73
1936 ..	1,500,000	27	73	72
1937 ..	1,500,000	21	79	70

These figures were taken from reports of the Raw Products Bureau of the National Canners Association. Accurate figures for subsequent years are not available and may never be since there is a suspicion that Golden Cross Bantam is now being produced and sold under other names.

Not less remarkable than the rapid increase in total acreage is the wide range throughout which Golden Cross Bantam proves to be adapted. It is now in successful large-scale commercial production from Illinois east to and including New York and south through Maryland. Indeed in Maryland it makes up about 40 per cent. of the total crop of sweet corn for canning, although open pollinated Golden Bantam was given up there prior to 1930 because of bacterial wilt. Golden Cross Bantam is now being grown successfully on a commercial scale in Oregon and Eastern Washington and in Western Idaho, though that is not important in the present relation.

The important point here is that from Illinois to the eastern seaboard, throughout practically all the region in which bacterial wilt was so destructive on sweet corn in 1931–1933, its host environment, so far as sweet corn is concerned, has become quite different. Instead of open-pollinated corn, so variable as to become locally adapted and not profitably planted far from the point of production, we have a very uniform single cross dominating sweet corn production over at least a thousand mile belt. Given a parasite which we know to be highly plastic, can any reasonable person assume that the population of this organism to-day can be the same as in 1931?

At some risk of seeming to attempt the dramatic I would like to emphasize the fact that the past decade is the first in the history of agriculture when one could speak of the modification of a corn parasite by a uniform host environment on a scale large enough to be readily observed, and expect to be taken seriously. I believe it may be literally true that never before in the history of corn culture has a corn parasite been exposed over a wide range to so uniform a host environment. Biologically, including of course its disease relations, we are transforming Indian corn from a freely cross-pollinated crop to a synthetic product.

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[5] H. A. Wallace, *New Republic*, November 8, 1939.

[6] G. L. McNew, *Phytopath.*, 27: 1161–1170, 1937.

[7] R. E. Lincoln, SCIENCE, 89: 159–160, 1939.

[8] G. L. McNew, *Phytopath.*, 28: 769–787, 1938.

Elsewhere I have pointed out a relation[9] which may indeed have been all but self-evident, namely, that among comparable crops there is a demonstrable difference as regards disease losses between open-pollinated crops produced from seed and similar self-pollinated crops, disease losses fluctuating more and being in general of greater importance in those plants which are largely self-pollinating.

In a field of open-pollinated corn, there is, I am told, even in the named varieties a wide range in genetic composition and, no doubt, also variation in susceptibility to many diseases. In such a field there is an observable variation in the time of silking and tasseling, and in the time at which plants reach a stage of susceptibility to infection by certain diseases. In contrast to this a field of "hybrid corn" is much more uniform in these respects.

To be sure, the corn now planted consists mostly of double crosses which are somewhat more variable in time of silking, etc., than single crosses. Certain careful growers also plant two crosses in a single field in order that they may still further reduce the hazards due to too great uniformity.

More important in relation to disease and disease-producing organisms is the fact that up until the last few years Indian corn apparently has been able to vary and adjust itself about as rapidly as the disease organisms themselves. Recent researches have shown that in general the common smut of corn, like most smut fungi, is parasitic only in the dicaryon stage, that is, it must cross to parasitize; that it is extremely heterozygous for many characters and consequently unstable; that variation is so common, even in unisexual lines, that from a single monosporidial line more than 150 distinct variants have been isolated; that different combinations of monosporidial lines differ greatly in their degree of pathogenicity and that some of them are so virulent as to kill the host outright.

No one supposes that this ability of the smut fungus or other fungi is recently acquired. It is very much more likely that the process has been going on for many centuries. It is hardly to be doubted that exceedingly virulent lines of smut may occasionally have appeared during these centuries, yet Indian corn survived and has been grown during recent years with a minimum of effective disease control, and apparently much less loss from disease than in the case of wheat.[10]

In corn we are dealing with a native plant, or at least one long cultivated in this area. In many of the places where we now grow corn, our Indian predecessors grew the same plant, which held its own against these same diseases when our ancestors were suffering from the black plague or arguing about the Post-Columbian pandemic of syphilis. All that is now changed and I believe permanently changed. Hybrid corn is here to stay. The increased yield, together with the ease with which seed is produced, makes its future all but certain. Almost equally certain seems to me the probability that we are changing the disease relations of this great crop.

By the wide use of hybrid corn we are depriving this important crop of its power of taking care of itself and by continued crossing and variation, continually adjusting itself to the equally variable parasites which attack it, and have substituted our own choice of parents for each field. In view of our none too brilliant record of success in so testing varieties of other grains as to insure them against loss from disease when planted over a wide acreage, it seems unlikely that we will have much greater success in dealing with corn. It seems much more probable that in spite of the best efforts of the breeders we will see for some years in hybrid corn a disease relation more nearly resembling that in wheat; that is, wider fluctuations in losses with some years very little damage and in others greater damage than has heretofore been observed. Eventually we may see lower average disease losses, but I sincerely believe that our corn breeders will be doing all that can reasonably be expected of them, if during the next ten years they keep the losses from disease in the new varieties, including losses in decay after harvesting, down to the general level of such losses in the old open-pollinated varieties.

OBITUARY

LAWRENCE JOSEPH HENDERSON

1878–1942

Lawrence Joseph Henderson, Abbot and James Lawrence professor of chemistry and chairman of the Society of Fellows in Harvard University, was born in Lynn, Massachusetts, on June 3, 1878. He died suddenly on February 10, 1942.

During the school years in Salem, his home contributed a code of behavior which persisted through life and an awareness of the learning of that day.

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[9] N. E. Stevens, Science, 89: 339–340, 1939.

[10] N. E. Stevens, *Scientific Monthly*, 52: 364–366, 1941.

Through his father's business interests in the island of St. Pierre, he early established an affectionate and lasting intimacy with France. In school, mathematics, which in later years served both as a tool and for relaxation, was easy; the only teacher whom he remembered with satisfaction taught him physics.

At the age of sixteen, he entered Harvard. Here it was possible for him to form habits of independence of thought and action which in college kept him from accepting the dicta of instructors or his fellows unthinkingly; in later years these habits were characteristic. An unorthodox performance of an experiment in physical chemistry produced unexpected results and persuaded Professor T. W. Richards to permit an investigation of their nature. As early as his sophomore year he had decided to enter biological chemistry, although no courses were offered in the college; and about this time he apparently began his thinking about the acid base equilibrium. Here he learned and mastered the generalizations of physical chemistry, then approaching its full vigor. As evidence for his understanding, he submitted an essay on Arrhenius' theory of electrolytic dissociation for a Bowdoin Prize Contest. Later, his knowledge bore much more valuable fruit.

Having received his A.B. degree in 1898, he took the generally accepted approach to biological chemistry and entered the Harvard Medical School, receiving his M.D. degree in 1902. But he never felt himself completely a medical student and lived in Cambridge, where began the friendships which were to lead for a time to an interest in philosophy. His medical studies were, however, by no means sterile. He learned the meaning of the Hippocratic teachings, acquired a thorough sense for biological phenomena, was initiated into problems which later deeply concerned him, and formed associations with physicians which he always treasured.

The years 1902–1904 were spent in Hofmeister's laboratory in Strassburg. And although they contributed little to his formal training, the associations with future leaders in physiology and biological chemistry did leave an impress and led to persistent friendships. There, too, his interest in hemoglobin began. He also observed a German university tradition already past its prime. And especially, he noticed certain German traits, among them an undiscriminating liking to obey authority, which later became generally offensive. Accentuated in Alsace-Lorraine, these traits produced a deep emotional impression upon him.

He returned to Harvard in 1904 as lecturer in biological chemistry, and soon decided that investigations of the acid base equilibrium were likely to prove more fruitful for him as a biological chemist than thermochemical studies chiefly concerned with the relation of heats of combustion to molecular structure. And so the next decade was devoted to studying the mechanisms involved in neutrality regulation in the animal organism and their explanation in quantitative physico-chemical terms, according to the theory of dissociation of weak acids. Meanwhile, his deeper curiosity, insight and a sense of order led him to perceive that "fitness is a reciprocal relation between an intricate pattern of properties of organisms . . . and an intricate pattern of properties of water, carbon, dioxide, and the compounds of the three elements, hydrogen, oxygen, and nitrogen."[1] This led to writing "The Fitness of the Environment," published in 1913. In 1917, influenced by the Royce Seminar, a more complete understanding of Willard Gibbs's study "On the Equilibrium of Heterogeneous Substances," and by his own habits of reflective contemplation and search for underlying uniformities, he completed "The Order of Nature." These books mark a turning point in his career, as he no longer felt constrained to concern himself only with the conventional application of physical to biological chemistry.

After a war-time digression into the physical chemistry of bread-making, he turned in 1919 to his important physiological studies. Already aware that numerous functional relationships existed in blood, he took advantage of the team spirit generated during war and led a group of investigators, already interested in the subject, simultaneously to investigate the variables involved. Before long it became possible to analyze the system in Gibbs's terms and to describe the simpler relations graphically with the aid of elementary mathematics. It was, however, necessary for him to learn and apply d'Ocagne's method of nomographic representation in order to reveal clearly the complex interrelationships. Although these studies continued until 1930, a synthesis was presented at Yale in the Silliman Lectures of 1928 and published as "Blood—A Study in General Physiology."

But several years before, about 1926, William Morton Wheeler had brought the Italian economist and sociologist, Pareto, to his attention. The "Traité de Sociologie Generale" had impressed Henderson as an accurate qualitative description and a workable classification of the uniformities found in all observed social systems. Once aware of its importance, he was impelled to master it by eager study, to lead others to an understanding of its implications and to test its validity. After 1930 his efforts wholeheartedly served these ends. By 1935 his last published book, "Pareto's General Sociology—A Physiologist's Interpretation," had appeared. A collection of privately distributed lectures and excerpts for use in the course, "Sociology 23—Concrete Sociology," indicates the intensity and extraordinary range of his reading and observation. Although the analogy of social systems to Gibbs's systems did not escape him, he realized that the time for quantitative treatment was not yet at hand. Without it, he was able to explain many phenomena observed in everyday relations between two or more persons, or between groups of individuals, in terms of the persistent uniformities which are the manifestations of sentiments. He increasingly stressed the study of man through concrete cases, and in 1941 appropriately emphasized this point of view in a course given to first-year students at the Harvard Medical School.

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[1] L. J. Henderson, unpublished ''Memories.''

Next to his intellectual pursuits, his relations to Harvard University were his most important interest for three quarters of his life. Eight years a student, he served it devotedly in the usual sequence of academic posts for thirty-nine years. He gave formal instruction in three subjects: biological chemistry, 1904–1939; history of science, 1911–1942; and sociology, from 1932–1942. All his courses had one common characteristic—they reflected the progress of his thinking. For example, in 1912 he read a large part of "The Fitness" to his class in Chemistry 15 before he had finished the book. Thus he managed to preserve vigor and freshness in each of these courses over extended periods, and because of the unusual breadth of his learning, students gained not only special knowledge, but also were given an insight into the cultural meaning of science.

With graduate students he practiced a policy that amounted almost to *laissez-faire.* An enrichment of their ideas was inescapable, as informally he generously and sympathetically applied the "eager clarity of his mind" to the innumerable intellectual and personal problems presented by curious young men. And he ever strove to induce them to develop the best in themselves.

His leadership was recognized in that he was enabled to establish the Laboratory of Physical Chemistry at the Medical School in 1920 and the Fatigue Laboratory at the Business School in 1927. Convinced that investigators should ordinarily master their own destinies, he gradually withdrew from the active direction of both laboratories. He did, however, continue his direct association with the Fatigue Laboratory to the end.

For a number of years President Lowell and Henderson had discussed means of aiding the development of original scholars. Consequently, the Society of Fellows was founded in 1933 with Henderson as its first chairman. It came to reflect many of his beliefs. Here a group of most promising young men, stimulated by interaction with each other and with a few of the university's most distinguished professors, learned of dignity and breadth in scholarship, became aware that human relationships were important, and were given a period of freedom from academic and financial pressure so that some might, through reflective thought, experiment or writing, fulfil the promise of productive scholarship.

It was inevitable that his contributions to knowledge and his own increasing wisdom should receive recognition; the former by honorary degrees, lectureships, and memberships in learned societies, and the latter by appointment to important committees. The latter responsibilities he undertook with energy and with characteristic persistence, if at all. As Foreign Secretary of the National Academy of Sciences, he had, with the Foreign Secretary of the Royal Society, arranged the Pilgrim Trust Lectureship before war broke out; recently he was actively concerned with Inter-American relations.

But it was at his camp in Morgan Center, Vermont, that the many facets of his personality shone most clearly. His love of symmetry appeared in the buildings he had designed; his love of beauty in nature as he sat on the porch gazing at the gentle scene before him. Here his essential kindness and human interest were manifest not only to invited friends but to neighbors of the countryside. This place he loved. Here he thought, worked and contemplated the world in serene inquiry.

Altogether, his life, which he had made so rich, satisfactory and stimulating, exemplifies the concept of the complex interactions of organism and environment to which his experimental studies, continued observations, unusually wide reading and contemplation had led him. Although he undoubtedly would have minimized the magnitude of his influence on the environment, it is apparent in the importance of his publications, through his formal teaching, and less apparent, but probably even more important, in his human relations, especially with young men, his leadership in institutions and the deep and abiding affection of those who had come to know him well.

RONALD M. FERRY

RECENT DEATHS

DR. C. HART MERRIAM, founder in 1885 and until 1910 chief of the United States Bureau of Biological Survey, now known as the Fish and Wild Life Service, until three years ago research associate of the Smithsonian Institution, died on March 19 at the age of eighty-six years.

PROFESSOR ADAM C. DAVIS, JR., head of the department of experimental engineering at Sibley College, Cornell University, died on March 17 at the age of fifty-two years.

FRANCOIS IRENEE DU PONT, research chemist, died on March 16 at the age of sixty-eight years. He was known for his discoveries in the field of smokeless powder and for his development of the minerals separation process.

ISABEL BEVIER, until her retirement with the title emeritus in 1922 professor of home economics and head of the department at the University of Illinois, died on March 17 in her eighty-second year.

WHARTON HUBER, curator of mammals in the Academy of Natural Sciences of Philadelphia, died on March 12. He had been a member of the staff of the academy since 1921.

SCIENTIFIC EVENTS

THE COMING HARVEST IN THE UNITED KINGDOM

A WIRELESS dispatch from Raymond Daniell to the *New York Times* reports that the British Minister of Agriculture, Robert S. Hudson, stated on March 18 in the House of Commons that the future history of Britain and perhaps of the world might depend on this year's harvest in the United Kingdom. He pointed out that meat supplies are dwindling and the shortage of merchant tonnage is becoming more acute; the nation is depending more and more on vegetables, and he made it clear that the advice of the Minister of Foods, Lord Woolton, to make up deficiencies in diet with vegetables could not be followed unless larger harvests from land already cultivated could be obtained.

Experts from the United States will go to England for consultation in an effort to increase production. Mr. Hudson stated that nearly all arable land is already in use, but that there is a shortage of manpower. There are more than 25,000 women enrolled in the agricultural army and it is still growing, but use will have to be made of school children and Italian war prisoners.

More than 80 per cent. of the farms consist of less than 150 acres. Many farmers earn little more than the laborers they hire to work in their fields. At the close of this ploughing season the tilled fields will amount to 6,000,000 acres more than before the war. The 1938 potato acreage of 700,000 acres already had been increased by more than 1,000,000 acres and will be further increased this year. Vegetable production generally had been increased from 2,500,000 to 4,000,000 tons. Oat and sugar-beet production also had been greatly increased. Germany had 70,000 tractors working on 4,000,000 farms in 1939, while Great Britain had 50,000 on 500,000 holdings. Mr. Hudson stated, however, that Germany was making poor progress in increasing the farm output of the occupied countries. Meats in Great Britain are now scarce, and the ration probably will have to be cut even further. Fuel and light soon will be rationed, and it is expected that for part of the time there will be no hot water.

REPORT OF THE TREASURER OF YALE UNIVERSITY

THE expenditures of Yale University for the fiscal year ended June 30 were $9,517,376, according to the annual report of George Parmly Day, treasurer of the university. Of this amount, $7,890,088 was for educational purposes, and the balance of $1,627,288, for the operation of the dining halls, the Athletic Association and maintenance of plant. The total income available was $9,492,005, leaving a deficit of $25,371.

Included in the income mentioned were gifts to the university from the Alumni Fund of $323,472 to meet current expenses, an increase of $2,062 over last year. Since its founding, the Alumni Fund, which was organized to raise endowment and provide funds for current expenses for the university, has made available $7,954,255 for income and has accumulated a principal of $5,664,568.

Yale paid out $6,312,249 in salaries to about 3,300 persons in and around New Haven—faculty and administrative and service employees—who constitute the university payroll, and to local firms for materials and services, $1,973,558, bringing the total expenditures made in New Haven to $8,285,807.

Statistics included in other parts of the report show that the twelve dining halls operated by the university served 1,665,978 meals during the year, and the weekly board rate, unchanged since 1933, is $8 for 21 meals; the University Library, with expenses of $494,007, added 106,000 volumes to its collections, bringing the total number of books to more than 3,000,000; the Athletic Association had expenses of $438,033 and income of $397,693, which left a deficit of $40,340.

The report listed gifts and bequests for endowment, exclusive of contributions to building funds, aggregating $1,994,019, bringing the total endowment to $112,096,810. Income derived from productive assets amounted to $3,932,964—an average return of 4.34 per cent. (The average was 4.32 per cent. in 1940, 3.97 per cent. in 1939 and 4.31 per cent. in 1938.)

Among the principal items of income listed in the report are: from investments and fiduciaries, $4,057,233; tuition, $2,198,527; gifts available for expenses, $1,063,629; and net income from dormitory room rents, $416,576.

JUNIOR ENGINEERING STUDENTS AND THE WAR INDUSTRIES

CONSULTATION with government and industrial officials has led the faculty of the College of Engineering of New York University to adopt a new accelerated war training program that will free trained junior engineering students for four months service with war industries by the middle of May. Under the plan, third-year students who have completed all the basic engineering studies will be released at that time to work with war industries for four months during the spring and summer; and the academic program of undergraduates will be accelerated by the elimination of most of the regular holidays during the academic year. As has previously been announced, some two hundred and fifty present seniors will complete their studies next month.

Under the continuous summer study program adopted by many engineering schools, no additional engineering personnel will be available much before next February. Approximately 1,100 engineering students will be affected by the war program at the college, with 250 juniors and some sophomores available to war industries this summer.

An important aspect of the newly adopted program will be the availability of the college classrooms and laboratories during the summer for defense research and for the continuance and expansion of the various government training programs now being conducted for the Army Air Corps, Ordnance Department, Signal Corps, Weather Bureau, Navy, U. S. Office of Education and other government agencies. In one instance alone, this will make possible an increase of 150 per cent. in the training of personnel for an important military bureau.

The plan includes an academic speed-up from September to April, makes the third-year students available for work in war industries this summer, and yet graduates the class of 1943 only two months later than does the modified speed-up or continuous summer study program, adopted by many institutions. The four months summer work experience will familiarize students with industrial procedures and practices. Employment in industry between the junior and senior years thus saves a corresponding amount of time after graduation.

The accelerated academic program, together with the plan for the production assistance to war industries, makes possible a year-round utilization of facilities, without depriving industry of much-needed personnel during the spring and summer.

Preliminary surveys among personnel directors of aeronautical firms in the East indicate that the eighty junior aeronautical engineers enrolled in college would probably all be placed on or before May 15, and reports from other sources indicate that there may be a larger demand for junior electrical engineers for the four-month period than the college will be able to meet. The demand for student engineers in other fields is also heavy. The students affected by the program at the college are studying administrative, aeronautical, chemical, civil, electrical and mechanical engineering and meteorology.

The students, after completion of summer work in war industries, will resume classes about September 15, and the returning fourth-year men will be graduated in April, 1943. The present sophomores, according to the plan, will be available for the next four-month employment period by May 15, 1943.

THE FINNEY-HOWELL RESEARCH FOUNDATION

AT the meeting of the board of directors of the Finney-Howell Research Foundation held in February, eight fellowships were awarded for the period of one year. These are:

Julius C. Abels, B.S., M.D., to work at Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York, N. Y.

Glenn Horner Algire, M.D., to work at the National Cancer Institute, Bethesda, Md.

Bernerd E. Kline, B.S., M.S., to work at McArdle Memorial Laboratory, University of Wisconsin.

Margaret Nast Lewis, A.B., Ph.D., to work at the Crocker Radiation Laboratory, University of California at Berkeley.

Alfred Marshak, B.S., Ph.D., to work at Crocker Radiation Laboratory, University of California at Berkeley.

Rose I. Shukoff, M.D., to work at the Glasgow Royal Cancer Hospital, Glasgow.

Emilia Vicari, to work at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor.

Benjamin Norman Horwitt, B.S., Ph.D., to work at Harvard University, Converse Memorial Laboratory.

Applications for next year must be in the hands of the secretary of the foundation by January 1, 1943.

THE PERMANENT SCIENCE FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

INCOME from the Permanent Science Fund, according to agreement and declaration of trust, shall be applied by the American Academy of Arts and Sciences to such scientific research as shall be selected ". . . in such sciences as mathematics, physics, chemistry, astronomy, geology and geography, zoology, botany, anthropology, psychology, sociology and economics, history and philology, engineering, medicine and surgery, agriculture, manufacturing and commerce, education and any other science of any nature or description, whether or not now known or now recognized as scientific, and may be applied to or through public or private associations, societies, or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants under this indenture are considered by a committee of this academy on stated dates only. The next meeting to consider applications will be held on October 1. Applications should be made on special forms furnished by the committee. Correspondence, including requests for application blanks, should be addressed to the chairman of the Committee on the Permanent Science Fund, Professor John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Grants-in-aid from this fund recommended by the committee were announced by the academy on March 11 as follows:

To Elso S. Barghoorn, Jr., instructor in biology, Amherst College, for miscellaneous expenses of field work and laboratory study of the structural changes in submerged wood and plant remains, $335.

To Thomas H. Bissonnette, professor of biology, Trinity College, Hartford, Conn., for expendable materials and assistance in a further study of photo-periodicity in animals, $400.

To Bart J. Bok, associate professor of astronomy, Harvard University, for the construction of a 26-inch circular mosaic grating to be used with a 24-inch Schmidt telescope, a joint project in collaboration with Dr. R. W. Wood, of the Johns Hopkins University, $750.

To Vernon I. Cheadle, assistant professor of botany, R. I. State College, for assistance in continuing a study of the conducting systems in the Monocotyledoneae, $350.

To Clark Goodman, research associate, the Massachusetts Institute of Technology, for construction of equipment to be used in continuation of a study of the locus and relative concentration of elements in ores by the use of induced radio-activity, $650.

To Cornelius S. Hurlbut, Jr., associate professor of mineralogy, Harvard University, for construction of equipment to be used in a study of refractive indices of amphibole and other minerals, $450.

To Fred M. Uber, assistant professor of physics, University of Missouri, for reagents for use in study of synthesis of kojic acid by microorganisms using C^{13} as a tracer, $425.

THE NUTRITION FOUNDATION

THE appointment of Ole Salthe, formerly consultant for the Federal Food and Drug Administration, as executive secretary of the Nutrition Foundation, Inc., organized by fifteen food manufacturers, as reported in SCIENCE for January 16, to study nutrition for the improvement of public health, has been announced. Scientific and industrial advisory committees have also been appointed. The foundation has headquarters at the Chrysler Building.

Members of the scientific advisory committee are:

Dr. F. G. Boudreau, director, Milbank Memorial Fund; Dr. C. A. Elvehjem, University of Wisconsin; Dr. Icie M. Hoobler, Children's Fund of Michigan; Dr. P. E. Howe, the Surgeon General's office, U. S. Army; Dr. E. V. McCollum, the Johns Hopkins University; Dr. L. A. Maynard, Cornell University; Dr. J. R. Murlin, the University of Rochester; Dr. Roy C. Newton, Swift and Company; Dr. Lydia J. Roberts, the University of Chicago; Dr. W. C. Rose, the University of Illinois; Dr. W. H. Sebrell, U. S. Public Health Service; Dr. Henry C. Sherman, Columbia University; Dr. F. F. Tisdall, the University of Toronto, and Dr. R. R. Williams, Bell Telephone Laboratories.

Members of the food industries advisory committee are:

Dr. Roger Adams, the University of Illinois, representing the Coca-Cola Company; H. A. Barnby, Owens-Illinois Glass Company; Dr. Frederick C. Blanck, the H. J. Heinz Company; Dr. Laurence V. Burton, "Food Industries"; Dr. Charles N. Frey, Standard Brands, Inc.; Frank L. Gunderson, the National Research Council; Dr. W. H. Harrison, the Continental Can Company; Norman F. Kennedy, the Corn Industries Research Foundation; Dr. Edward F. Kohman, the Campbell Soup Company; Donald Maveety, the National Biscuit Company; Dr. Robert W. Pilcher, the American Can Company; Dr. G. L. Poland, the United Fruit Company; Alan C. Richardson and James McConkie, the California Packing Company; Dr. E. H. Robinson, Swift and Company; Dr. James A. Tobey, the American Institute of Baking, and Lewis W. Waters, the General Foods Corporation.

SCIENTIFIC NOTES AND NEWS

THE Borden Company Prize of $1,000 of the American Chemical Society for "outstanding research in the chemistry of milk" has been awarded for 1942 to Dr. George E. Holm, biochemist of the Bureau of Dairy Industry of the U. S. Department of Agriculture, in recognition of "his contributions to the understanding of the basic causes and the control of oxidative deterioration of fats and oils, and to the prevention of spoilage of dairy products caused by the oxidation of milk fat." Leroy S. Palmer, professor of agricultural biochemistry at the University of Minnesota, was chairman of the committee of award, other members of which included Dr. Roy C. Newton, chief chemist of Swift and Company, Chicago, and Dr. R. Adams Dutcher, head of the department of agriculture and biochemistry at Pennsylvania State College.

John D. Rockefeller, Jr., has been awarded the medal of honor for city planning in recognition of "his unique services to professional ideals." The medal was presented to Mr. Rockefeller at his offices on March 10, together with a scroll commending his "broad vision and initiative." "They have enabled him to plan numerous civil projects, the influence of which has been inspiring to the present generation and the effect of which will shape and help to determine the constructive forces of the future." The citation was signed by the presidents of the societies making the award: Harvey Stevenson, New York Chapter, American Institute of Architects; Joseph Mathieu, Brooklyn Chapter, American Institute of Architects; Michael Rapuano, New York Chapter, American Society of Landscape Architects, and Dean G. Edwards, Metropolitan Section, American Society of Civil Engineers.

The Joseph A. Capps Prize in medical research for 1941 has been awarded to Dr. Arnold Lazarow for his study on "Particulate Glycogen: a Submicroscopic Component of the Guinea Pig Liver Cell; its Significance in Glycogen Storage and the Regulation of Blood Sugar."

Dr. Dinsmore Alter, director of the Griffith Observatory, Los Angeles, has been awarded the degree of doctor of science by Monmouth College, Illinois.

Dr. Arno B. Luckhardt, professor and chairman of the department of physiology, School of Medicine, University of Chicago, has been elected an honorary member of the St. Louis Medical Society.

At the forty-seventh annual meeting on March 13 and 14 of the Michigan Academy of Science, Arts and Letters, officers were elected for the coming year as follows: *President*, H. R. Hunt, Michigan State College; and from the University of Michigan, *Vice-president*, Malcolm H. Soule; *Secretary*, Harry W. Hann; *Treasurer*, Mischa Titiev; *Editor*, Henry van der Schalie; *Librarian*, Warner G. Rice. General addresses were delivered by Dr. I. D. Scott, professor of geology at the University of Michigan and president of the academy, and by Dr. A. F. Blakeslee, of the Carnegie Institution, Cold Spring Harbor, N. Y.

Dr. Wilford Arless Risteen, Rochester, N. Y., has been appointed professor and head of the department of neurologic surgery at the University of Georgia School of Medicine, Augusta. He succeeds the late Dr. Richard Frank Slaughter.

Professor S. W. Edgecombe, horticulturist in the extension staff of Iowa State College, has been appointed associate professor in plant science at the University of Manitoba.

Dr. Frank Riecken, of the University of Illinois, has been appointed research assistant professor of soils at Iowa State College.

A revision in organization has been effected throughout the University of Oklahoma by the action of the new president, Joseph A. Brandt. The titles of all department heads have been changed to chairmen, and general changes in personnel have been made correspondingly. The former heads of departments retain their professorships and salaries. In the scientific departments the new appointments are as follows: *Botany and Bacteriology* (to be called Plant Science), Dr. G. L. Cross is replaced by Dr. Milton Hopkins as chairman; *Chemistry*, Dr. Guy Y. Williams by Dr. Bruce Houston; *Physics*, Dr. H. L. Dodge by Dr. G. A. Van Lear; *Psychology*, Dr. L. B. Hoisington by Dr. M. O. Wilson; and *Zoology* (now consolidated with physiology, of which Dr. Alma J. Neill had been acting head, as the Department of Animal Biology), Dr. A. Richards by Dr. A. I. Ortenburger.

Dr. Hugh H. Young, editor of the *Journal of Urology*, having reached the age of seventy-one years, will retire on July 1 as professor of urology and as director of the Brady Urological Institute at the Johns Hopkins Hospital. He plans to keep an office in the Brady Institute and to devote himself to clinical research and writing.

The council of the Zoological Society of London has temporarily suspended the position of secretary of the society, held by Professor Julian Huxley, "because of financial stringency owing to the war." Professor Huxley has been criticized in the House of Commons for opinions expressed during his visit to the United States.

Dr. Willard C. Rappleye, commissioner of hospitals of New York City since October, 1940, has resigned to return to his work as dean of the College of Physicians and Surgeons of Columbia University. Dr. Rappleye, who succeeded Dr. S. S. Goldwater as commissioner, had planned to retire in January, but was persuaded by the mayor to remain in office somewhat longer.

Dr. Fred L. Adair, Mary Campau Ryerson professor of obstetrics and gynecology and chairman of the department of the School of Medicine of the University of Chicago, has become chief of the State Division of Maternal and Child Hygiene.

The editorship of the *Journal of Parapsychology* has been changed. For the past three years, Dr.

Gardner Murphy, of the College of the City of New York, and Dr. Bernard F. Riess, of Hunter College, have edited it. The editorship of the *Journal* now returns to Duke University, where it was first started. The new editors are Drs. J. B. Rhine, Charles E. Stuart and J. G. Pratt, with Dr. J. A. Greenwood as statistical editor.

JULIAN F. SMITH will relinquish his work as associate director of the Hooker Scientific Library at Central College, Fayette, Mo., of which Dr. Neil E. Gordon is director, to become technical librarian and editor of publications of the Institute of Gas Technology. To give him time to make the change the Institute of Gas Technology has arranged to divide his time between the two institutions for several months. He will continue later to act in an advisory capacity.

DR. GEORGE S. MYERS, professor of biology and head curator of zoological collections of Stanford University, will leave in June for a year's study and travel in Brazil, under a grant from the State Department in Washington. Dr. Myers will make his headquarters in the Museu Nacional in Rio de Janeiro, where he has been requested to present a series of lectures on Brazilian fishes and fisheries resources and to take charge of the advanced training and research of a selected group of Brazilian ichthyological students. He will also travel in different parts of the country to study fishes and fisheries industries.

THE *Journal* of the American Medical Association reports that the Second U. S. Army General Hospital Unit, consisting of fifty-five members of the staffs of the College of Physicians and Surgeons, the School of Dental and Oral Surgery and the Columbia-Presbyterian Medical Centers, Columbia University, have been called to active duty. The chief of the surgical service is Dr. W. Barclay Parsons, associate professor of clinical surgery, and the chief of the medical service is Dr. Yale Kneeland, Jr., assistant professor of medicine, both of whom are lieutenant colonels. Other members of the faculty have been granted leave of absence to enter active service with the Medical Corps of the Army and Navy.

DR. H. M. TYSDAL, agronomist, of the division of forage crops and diseases of the U. S. Department of Agriculture, and of the department of agronomy of the College of Agriculture, University of Nebraska, gave the eleventh series of Frank Azor Spragg Memorial Lectures at Michigan State College early in March. The memorial lecture proper dealt with "New Aspects of Forage Crop Improvement." The four other lectures were on related subjects.

THE seventh Leo Loeb Lecture under the annual lectureship which has been established by the Mu Chapter of the Phi Beta Pi Medical Fraternity was delivered on March 23 by Dr. John Herr Musser, professor of medicine at Tulane University, at the Washington University School of Medicine, St. Louis. He spoke on "The Heart That is Getting Old."

THE sixtieth course of popular medical lectures of the School of Medicine of Stanford University will be given on April 3 and 17 and May 1 and 15. These are as follows: "The Blood Bank," Dr. John R. Upton; "Medical Aspects of Civilian Defense," Dr. Anthony J. J. Rourke; "Alcohol in Relation to Driving Hazards," Dr. Henry W. Newman; "Control of Venereal Disease under War Conditions," Dr. Charles W. Barnett.

DR. J. O. PERRINE, assistant vice-president of the American Telephone and Telegraph Company, gave a lecture-demonstration on March 26, entitled "The Electrical Voice," before the Lancaster Branch of the American Association for the Advancement of Science.

THE forty-second annual meeting of the American Association of Pathologists and Bacteriologists will be held at the Washington University School of Medicine, St. Louis, on April 2 and 3.

THE thirty-fifth annual meeting of the International Association of Medical Museums will be held at the Washington University School of Medicine, St. Louis, on April 1, under the presidency of William H. Feldman, Rochester, Minn.

THE thirty-seventh annual meeting of the American Association of Museums will be held at Colonial Williamsburg, Virginia, on Monday and Tuesday, May 18 and 19.

THE Pennsylvania Academy of Science will hold its eighteenth annual meeting at the Edinboro State Teachers College, Erie Co., Pa., on April 3 and 4. The Junior Academy will hold its meetings at the same time and place. Dr. A. Glenn Richards, Jr., of the University of Pennsylvania, will give the principal address. He will speak on "The Present Status of Electron Microscopy in Biology."

DURING the meetings of the Federation of Societies of Experimental Biology and Medicine, in Boston, the Boston and Cambridge Branch of the American Association of Scientific Workers is planning a threefold program of special interest to biologists and medical men. On Wednesday, April 1, at 8:00 P.M. a public lecture will be held at Littauer Center in the Harvard Yard, Cambridge. The speaker will be Dr. C. C. Little, director of the Cancer Research Laboratory at Bar Harbor, Maine, whose subject will be "The Social Implications of Cancer Research." On Friday, April 3, two meetings will be held in Room 22 at Boston

University College of Liberal Arts (corner of Boylston and Exeter Streets). In the afternoon a series of scientific films will be shown between 4:45 and 5:45. At 8:00 P.M. of the same day, again at Boston University, there will be held a symposium on "Biology and Medicine in the War." Among those participating are Dr. Maurice B. Visscher, of the department of physiology of the University of Minnesota; Dr. Lucien Brouha, formerly of Liége, Belgium, and now of the Harvard Fatigue Laboratory; Dr. C. W. Walter, of the Harvard Medical School, and Dr. Harry Grundfest, of the Rockefeller Institute for Medical Research. All members of the federation and others in the Boston area are invited to attend.

DISCUSSION

ON THE STRIDULATIONS OF INSECTS

RECENTLY some articles have appeared on the effect of temperature on the stridulations of crickets. My interest in temperature control, stimulated by some of these reports and the presence of a very noisy insect in our back yard, prompted me to make some observations as described in the following paragraphs.

The insect was of the genus "Oecanthus" of the order "Orthoptera" and seemed to maintain a location of about three feet above the ground in the middle of a Spirea bush. A mercury thermometer was placed at the edge of the bush near the same level as the insect. The number of stridulations per minute were counted manually and record made of the temperature, simultaneously. Readings were taken every day from August 12 to September 10, the temperature passing through a range of 55 degrees to 85 degrees (F) during this period. The stridulations commenced at seven P.M., and this starting period did not vary more than five minutes on successive evenings. From about seven to seven-thirty o'clock the stridulations were quite irregular with interruptions occurring every half minute. After about seven-thirty they would proceed without interruption until the early hours of the morning. A total of 100,000 stridulations would occur on a warm night (no time out for lunch) as a fair estimate.

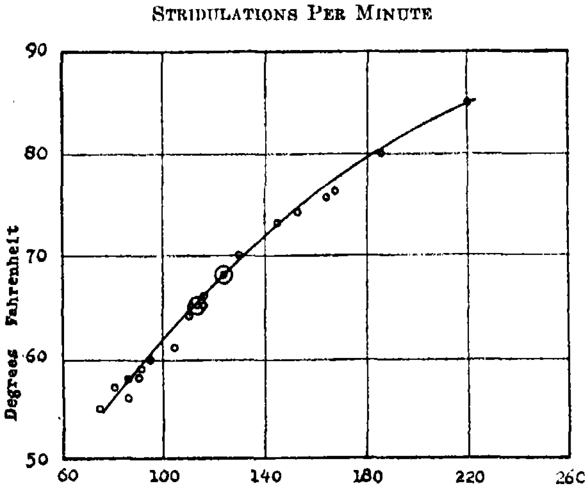

FIG. 1. Graph showing relation of stridulations of tree cricket (Oecanthus) to ambient temperature changes, readings taken each night from August 12 to September 10, 1941.

Data were taken at nine o'clock each evening in the interest of uniformity, as by that time the fall of temperature due to the setting of the sun had reached a point where the temperature gradient between the thermometer and the insect would be reduced to a minimum.

Observations, as shown by the graph in Fig. 1, indicate a very definite relation of periodicity of stridulation and ambient temperature. It is probable that sensitive recording apparatus would show a more uniform relation. Readings taken on different days at the same temperature were in close agreement. At 55 degrees the low limit of stridulatory power was reached, and the magnitude of the sound at this temperature was quite reduced from normal. At 54 degrees no audible sound was present. The points on the graph enclosed by circles were observations taken on a similar insect, August 23, at River Forest, Ill. The points coincide with the curve, showing a remarkable duplicity in insect life.

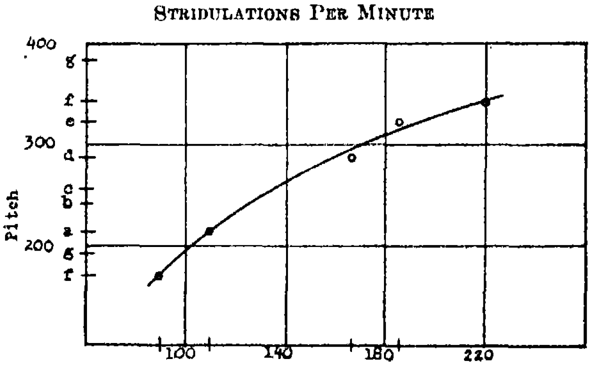

FIG. 2. Graph showing stridulations per minute in relation to pitch as compared to keys on piano. The numbers on the abscissa are vibrations per second and the keys are indicated in their approximate relation to this vibration. The keys plotted are those that came nearest to be in union with the pitch of the stridulation. (The key c is middle c on piano.)

The stridulation seems to be made up of two movements. There is an outward movement of the wings at each stridulation, and as the movement reaches maximum position, membranes in the wings vibrate. The graph shown in Fig. 2 indicates the pitch of the stridulation in reference to its periodicity. As the pitch was determined from keys on the piano some variation could be expected as the key indicated was chosen as being nearest to the pitch. It will be noted that a range of one octave on the piano was covered by a change in temperature from 59 degrees to 85 degrees. From the data it is evident that the mechanism that moves the wings as well as the membranes in the wings are very sensitive to temperature, and response to temperature changes is of marked uniformity.

HOWARD D. MATTHEWS

DETROIT, MICH.

THE RELATIVE EFFECTS OF ANOXIA

BECAUSE of recent interest shown in the problem concerning the relative effects of anoxia upon old and young animals, a reference by Moreland[1] to the work of Buffon, of LeGallois and of Edwards[2] should be brought to more general attention. Interest in the work of these early investigators lies in the fact that many recently reported results are substantially in agreement with results reported 125 years ago.

J. M. JOHLIN

SCHOOL OF MEDICINE,
VANDERBILT UNIVERSITY

CALENDAR REFORM AND 364-DAY YEARS

IN SCIENCE of February 20 it is stated that present calendar defects make the arrangement of schedules for industry and education difficult and temporary only, also that there can be no doubt about what would happen in calendar reform, if scientists had their way. A large percentage (76 per cent.) gave affirmative answers to the question whether or not a revised world calendar of 12 months and equal quarters should be adopted.

Some years ago when the Eastern Orthodox Churches changed to our Gregorian calendar, a clause was added expressing hope that Western nations might soon be ready to improve that calendar.

The World Calendar involves the interpolation each year of a so-called *Year day* or *extra Saturday.*

In this connection the possibility of making the astronomical year coincide with the calendar year might be considered. If the change to a calendar year with 12 months and equal quarters is made, the first years might be assigned only 364 days, omitting the disputed *Year day.* After eight such years, the winter solstice (occurring now about December 21) would coincide with the *Year day.* Thereafter the calendar quarters would correspond approximately to the astronomical quarters. The period of eight years would give the world time to experience the greater convenience of the new calendar. Before the end of that period many people might come to favor the new plan who now have never heard of it or are skeptical.

January 1, 1943, comes on a Friday; two years later, on a Monday. With ideas changing from national to international along many lines, perhaps we may now also think about the coming world calendar. To take away a day a year need be no more disturbing than the present adding a day in leap years. We have recently witnessed the ease with which the whole United States can drop or add an hour on a specified day.

ALFRED GUNDERSEN

BROOKLYN, N. Y.

A STUDY OF FAUNAL DISTRIBUTION

I SHOULD like to take the opportunity of acknowledging in SCIENCE the generous support that E. P. Mumford, of Jesus College, Oxford, and I have received in America in connection with a cooperative study of faunal distribution with particular reference to oceanic islands. This comprehensive study of island populations seeks to promote a wider approach to the basic problems of the origin of species. It was initiated at Oxford in October, 1938, with the aid of grants from the Higher Studies Fund, the Royal Society and the British Association for the Advancement of Science. Since the war, the work has been carried on by Mr. Mumford as a member of the faculty at Stanford University, California, in association with Oxford, with the aid of supplementary grants from the Carnegie Corporation of New York, the National Academy of Sciences, the American Philosophical Society, the American Association for the Advancement of Science, the Society of Sigma Xi and the May Esther Bedford Fund, Inc. Mr. Mumford and I are deeply indebted to these organizations for their support as well as to the officers and trustees of Stanford University, where he has been extended every facility in the prosecution of his researches. Among the scientists at Stanford who have been most helpful, mention should be made of Dr. Ray Lyman Wilbur, chancellor of the university, Professor C. V. Taylor, Professor Eliot Blackwelder, Professor E. G. Mears and Dr. H. A. Spoehr, director of the Carnegie Institution there. Thanks are due also to Dr. Frank Aydelotte, of Princeton University, and the Rhodes Trust, for unfailing support.

In view of the importance of Anglo-American relationships, it is perhaps of interest to note that Mr. Mumford first went to America with one of the Commonwealth Fund Fellowships, designed for the promotion of "mutual amity and understanding between Great Britain and the United States," after which he was invited to accept the directorship of the Pacific Entomological Survey (*Nature*, 141, 196, 1938). This position he held until he came up to Oxford, at the invitation of my predecessor, Sir Edward Poulton, as a Leverhulme research fellow.

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[1] F. B. Moreland, A thesis presented to the faculty of Vanderbilt University, 1936.

[2] W. F. Edwards, "On the Influence of Physical Agents on Life." Translated from the French by Hodgkin and Fisher and published by Haswell, Barrington and Haswell, Philadelphia, 1838.

It is to be hoped that this project now being carried on in association with Oxford and Stanford Universities will not only serve the advancement of science as such, but also aid the promotion of cordial relationships between English and American scientists interested in the basic problems of evolution.

G. D. HALE CARPENTER,
Hope Professor of Zoology (Entomology)
UNIVERSITY MUSEUM,
OXFORD, ENGLAND

SCIENCE TWENTY-FIVE YEARS AGO

THE RELATIONS BETWEEN ENGINEERING AND SCIENCE[1]

As engineering adopts the knowledge which science has correlated it simultaneously unearths new uncorrelated knowledge. Science indeed correlates this in turn, but not instantaneously, so that engineering has always at its hand both that which science has correlated and its own empirical discoveries which science has not yet had time to arrange. As optimists we may well expect that this uncorrelated knowledge will form a gradually decreasing fraction of the whole, but can we expect it ever to vanish completely? Must not science's approach to exclusive leadership be asymptotic?

We begin to get a glimmering of the vastness of the scheme of creation when we remember that every lengthening of man's artificial vision by means of telescope and camera, every new strengthening of telescope, sensitizing of plate, and lengthening of exposure brings a proportional increase in the number of visible suns, telling us that even at that inconceivable distance we have not begun to approach the limit of the discoverable universe. When we turn from telescope to microscope and thence to the inferred constitution of matter, we find with every new refinement of observation and inference a proportional addition of new wonders, a proportional increment in the complexity of natural phenomena. Hence while we may speculate that, as there must be a place where the stars end, so there must be a degree beyond which the subdivision of matter can not go, and a limit to the number of nature's laws, we may well ask whether either that limit or the limit of stellar space will be reached in that little throb in the pulse of the universe which we call the habitable period of this earth. Will man survive long enough to complete the discovery of all laws, so that no uncorrelated phenomena will remain for the engineer to unearth?

The second of the two considerations which tend to postpone the completion of science's leadership is that the beautiful as distinguished from the useful and the good will increase without limit its demands upon the work of the engineer. Though the beautiful itself should in time be capable of complete mathematical analysis, who shall say that that time, now seemingly so inconceivably remote, can arrive during man's earthly stay?

HENRY M. HOWE

OUR PSYCHOLOGICAL ASSOCIATION AND RESEARCH[1]

IT is our business as individuals and especially as united in this American Psychological Association to use all possible efforts at all times, in all places and in all ways to improve the conditions under which research work is done. Science has doubled the length of human life and quadrupled the productivity of labor. A single advance in applied science, such as the Bessemer steel process or the electromagnet, discovered by Faraday in the only research laboratory then existing, may add annually some two billion dollars to the wealth of the world. The psychological and social sciences have already done their share in freeing us from superstition and unreason, in leading us to tell the truth as we see it and in some measure to see the truth as it is. They have repaid many fold their cost in economic applications. An improvement of ten per cent. in the educational work of this country saves us a hundred million dollars a year. But it is to the future that we look to obtain a control over human conduct corresponding to that of physical science over the material world, and more vital. We must eliminate the incalculable waste of preventable idleness, misfit employment, disease, vice, crime and war; we must divide wealth more fairly and use it more wisely, we must alter fundamentally all our institutions, the family, the church, the school, the courts, government and the rest; each must be enabled to give what he best can and to receive what he most needs. And, as I said twenty-two years ago—before that "infant industry" eugenics had begun its career—in my address as president before this association:

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[1] Concluding part of the introductory address of the chairman of the Section of Engineering of the American Association for the Advancement of Science, New York, December 29, 1916, printed in the issue of SCIENCE for March 23, 1917.

[1] Concluding paragraph of the address given on the occasion of the twenty-fifth anniversary of the American Psychological Association, New York, December 29, 1916, printed in the issue of SCIENCE for March 23, 1917.

> We not only hold the clay in our hands to mould to honor or dishonor, but we also have the ultimate decision as to what material we shall use. The physicist can turn his pig-iron into steel, and so can we ours; but he can not alter the quantities of gold and iron in his world, whereas we can in ours. Our responsibility is, indeed, very great.

J. MCKEEN CATTELL

NOTES

THE portrait by Henry Ulke of Joseph Henry, first secretary of the Smithsonian Institution, has been transferred by a senate resolution, from the Capitol to the Smithsonian Institution, where it has been hung in the National Gallery of Art, in the new building of the National Museum.

DR. ALEXANDER GRAHAM BELL, inventor of the telephone, was awarded the Civic Forum Gold Medal for distinguished public service in New York on March 21. The presentation address was made by Dr. John H. Finley, state commissioner of education. Dr. Bell is the third recipient of the medal. It was awarded to Major General George W. Goethals in 1914, and to Thomas A. Edison in 1915.

DR. WILLIAM H. WELCH was the guest of honor at the tenth annual banquet of the Æsculapian Club, Philadelphia, on February 6.

THE portrait of Professor R. D. Salisbury, planned for by his former students, was presented to the University of Chicago on the afternoon of February 8.

THE Adams prize at Cambridge has been awarded to J. H. Jeans, M.A., sometime fellow of Trinity, for an essay on "Some Problems of Cosmogony and Stellar Dynamics." No election has been made to the Isaac Newton Studentship.

PROFESSOR A. N. WHITEHEAD has been elected president of the British Mathematical Society.

THE membership of the Botanical Committee of the National Research Council has just been completed, as follows: From the National Academy, J. M. Coulter (chairman), D. H. Campbell, R. A. Harper; from the American Association for the Advancement of Science (Committee of One Hundred), George T. Moore, B. E. Livingston, L. R. Jones; from the Botanical Society of America, Erwin F. Smith, Edward M. East and H. H. Bartlett.

DR. FABIAN FRANKLIN, associate editor of the New York *Evening Post* since October, 1909, has resigned. Dr. Franklin was professor of mathematics in the Johns Hopkins University from 1879 to 1895.

DR. ROBERT GRANT AITKEN, astronomer in the Lick Observatory, has been granted by the University of California four months' leave of absence to go to the Atlantic coast to complete arrangements for the publication of his work on the double stars.

PROFESSOR WALDEMAR LINDGREN, of the Massachusetts Institute of Technology, has gone to Chile in connection with geological work on some of the copper properties.

DR. JOSEPH A. BLAKE, formerly professor of surgery in Columbia University, who has rendered distinguished services at Neuilly and at Ris-Orangis, has accepted an invitation from the French government to become head of the great Doyen Hospital.

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, has been elected chairman, and Dr. S. W. Stratton, of the Bureau of Standards, secretary of the military committee of the National Research Council.

SCIENTIFIC BOOKS

CYTOLOGY, GENETICS AND EVOLUTION

Cytology, Genetics and Evolution. By twelve authors. Philadelphia: University of Pennsylvania Press. 168 pages, 19 figures. 1941.

THIS little book represents a survey of the subject as a part of the bicentennial celebration of the founding of the University of Pennsylvania. The papers are grouped into four departments, with three in each group: Chromosomes and Heredity, Cytogenetics and Evolution, Cytology and Genetics of Protozoa and Physiology of the Nucleus. The contributors and their subjects run as follows with a brief summary quoted in each case:

Demerec, M. "Nature of the Gene." "Thus an attractive possibility is open for speculation that each salivary band may consist of a single molecule, which is repeated a great many times, the length of the molecule determining the width of the band."

Metz, Charles W. "Chromosome Structure." "No one knows just what a chromosome is or how it is constituted."

Schrader, Franz. "The Sex-chromosomes, Heteropycnosis and its Bearing on Some General Questions of Chromosome Behavior." "The evidence from a wide range of cases strongly indicates that during a certain period of the meiotic prophase there is a definite and specific tendency for all heterochromatin to come together."

Blakeslee, Albert F. "Cytogenetics and Evolution." "Interchanges are only one of the types of chromosome alteration which have evolutionary significance."

Dobzhansky, Th. "Chromosome Differences between Races and Species of Drosophila." "It seems justifiable to conclude that, with the exception of translocations, all the types of chromosome changes which are known to differentiate its species are met with in races as well."

McClung, C. E. "Evolution of the Germ Plasm." "We are certain of the continuity of germ plasm, and of the general nature of the material record of racial experience. It seems evident that the hope for an understanding of racial and individual development waits upon a fuller knowledge of the nature and behavior of the visible elements which embody the germ plasm."

Jennings, H. S. "Hereditary Status of Rhizopods." "There is nothing known as to Mendelian heredity in Rhizopods. There is no knowledge of inheritance and variation in sexual reproduction. . . . It deals with heredity and variation in reproduction from a single parent, in vegetative reproduction. . . . There remains the question: Is it the chromosomal materials, is it the genes that become altered when hereditary diversities are produced in a single clone through the action of the environment or otherwise? Jollos is of the opinion that it is *not* the chromosomal materials that are altered."

Diller, William F. "Nuclear Behavior and Reproduction in Ciliated Protozoa." "Underlying all the apparent diversity and variability of nuclear phenomena one comes to discern a fundamental similarity whose expressions are differences in degree and not in kind."

Sonneborn, T. M. "Inheritance in Ciliated Protozoa." "I have reviewed in this paper some situations in ciliate genetics, in which typical genetic inheritance is unquestionably involved, but I have also attempted to set forth a number of situations, including by far the greater part of what is known about ciliate genetics, which are extremely difficult to interpret along orthodox genic lines. . . ."

Churney, Leon. "The Physico-chemical Properties of the Nucleus." The author discusses the properties under the headings: Colloid chemical properties of the nucleus and cytosome, viscosity, osmotic properties of the nucleus, permeability of the nuclear membrane to water, amphoteric properties of the nuclear constituents.

Duryee, William R. "The Chromosomes of the Amphibian Nucleus." "Facts such as these offer strong support to commonly accepted genetic theory, that master molecules or molecular templates, as genes have been called, remain imbedded in the axis cylinder, ready to divide in mitosis and become distributed for work in some future cell."

Henshaw, Paul S. "Radiation and the Cell Nucleus." "As a consequence the exponential dose-action curves, in so far as they are reliable, may be taken to indicate that biologic changes as extensive as cell death may be induced by single event action—perhaps even by the production of single ion pairs."

These authors present a brief summary of important problems in their fields. The tentative nature of the subject is indicated strongly and the line of future work pointed out. Naturally, in so diversified a subject, there is lack of agreement, but it is surprising to see how far it really obtains on broad general principles. There is, for instance, practically no disagreement with regard to the chromosome theory of inheritance. Expressed or implied, it lies at the basis of each paper. In view of the fact that the subject of cytology is but seventy-five years old, and modern genetics but forty years, this is not a bad record. As presented in the symposium here it offers a very hopeful prospect for future developments.

C. E. McClung

OCCUPATIONAL DISEASES

Occupational Diseases. Diagnosis, Medico-legal Aspects and Treatment. By Rutherford T. Johnstone. 558 pp. Philadelphia and London: W. B. Saunders Company. 1941.

This is an excellent book written by a man who has had years of experience not only in the diagnosis and treatment of a wide variety of industrial diseases but also in that newer and increasingly important field, the dealing with claims for compensation. The book covers the most important industrial poisons; the dusts, injurious and inert; the dermatoses; injuries from physical agents, and there is also a chapter on "the industrial back" and on hernia, and a full discussion of traumatic neuroses and malingering.

A chemist would be puzzled over the choice of title for the first section, "Gases, Solvents and Fumes," and still more by the groupings under this title. The halogenated hydrocarbons are scattered through five chapters, instead of being treated as a group, and such diverse bodies as nitrobenzene, dichlorofluoromethane and ethylene dichloride are grouped together. However, this does not really produce confusion and is of minor importance. What is of major importance is Dr. Johnstone's selection of material. He very wisely gives little space to the earlier literature, which is abundantly covered in the older textbooks, and instead covers fully the very latest contributions. This is especially well illustrated by the chapters on benzol, carbon tetrachloride, carbon disulfide and carbon monoxide.

The material for the book was gathered in a clinic which for 25 years has offered medical and surgical industrial service and which evidently is a consultative center for a large part of California, handling some 11,000 patients a year. It was opened soon after the passage of the Workmen's Compensation Act, which covered diseases of occupation as well as accidents, and thus, from the first, this aspect of industrial medicine was of great importance and recurs again and again in the discussion of individual cases. Dr. Johnstone's attitude toward the medico-legal problems is eminently fair, free from over-indulgence but equally free from a hard-boiled scepticism. It is evidently the result of long experience on a mind free from prejudices and is perhaps most clearly shown in the section on neuroses and malingering.

A mild criticism might be made of one or two subjects. Nitrous fume poisoning is rather too briefly handled, considering its great importance in the production of high explosives and in welding. The diagnosis of lead poisoning, based on history of exposure, clinical symptoms and laboratory findings, is very well dealt with, but the picture given under the heading "Suggestive evidence of incipient intoxication and inactive or arrested plumbism" would by many physicians be called "definite and active plumbism," requiring suspension from lead exposure, even if no disability is found. It seems to this reviewer that the connection between chronic plumbism and peptic ulcer, nephritis and vascular damage is dismissed too lightly in view of the available evidence.

There are indications of rather hasty preparation in some places (talc is included among the silica-containing dusts on page 307, but correctly classed as hydrated magnesium silicate on page 305) and the proofreading is surprisingly faulty for a Saunders book; "consistency" for "constituents," "ascribed to" for "described," and one whole line misplaced on page 335.

One very good feature of the book remains to be mentioned, the sections on treatment, which are detailed and clear, not general and vague as is too often true in books of this kind.

ALICE HAMILTON

DIVISION OF LABOR STANDARDS,
WASHINGTON, D. C.

REPORTS

GRANTS MADE BY THE BANTING RESEARCH FOUNDATION

THE Banting Research Foundation reports that grants made to individuals working on medical problems in different parts of Canada last year were instrumental in furthering research of considerable interest in several fields. Following are brief summaries of work performed by those holding grants during part or whole of last year.

To test the accepted hypothesis that oxidation of α-estradiol to estriol, or hydration of estrone to estriol, takes place in the uterus under the influence of progesterone, W. S. Bauld, of Dalhousie University, working with Dr. R. D. H. Heard, showed that in the rabbit this transformation occurred.

W. H. Feindel and Dr. C. B. Weld, at Dalhousie University, studied the permeability of the eye membranes in dogs to the sugars xylose, glucose, sucrose and raffinose. It was found that their penetration into the aqueous humor was inversely related to their molecular size, and that raffinose represents the approximate limit of the size of the molecule which passes through the membranes.

Dr. K. C. Fisher, of the University of Toronto, extended his investigation of the mechanism of the action of anesthetics to include a broad variety of narcotic agents and cells. The initial interpretation, namely, that the metabolism of a cell is separable into two independent parallel fractions, has been fully borne out.

A. G. Gornall, of the University of Toronto, found that in ureasynthesis studies the accumulation of citrulline occurred in liver slice saline containing $NH_3 \cdot CO_2$, lactate and ornithine. This research forms an important step in our knowledge of the means by which urea is formed in the body.

Dr. Mavis Gunther, of the University of Toronto, has made a survey of the progress of lactation in a series of women. She has accumulated statistics of when and why infants are weaned and has analyzed the causes of women being unable to nurse satisfactorily.

M. M. Hoffman, of Dalhousie University, working with Dr. R. D. H. Heard, has furnished experimental confirmation of the hypothesis that the urinary oestrogen, oestrone, arises in the body from the ovarian follicular hormone, α-oestradiol. The metabolism of the corpus luteum hormone was also investigated and it was found that in the rabbit, as in the human, pregnane-3 (α), 20 (α)-diol is the main excretory product and the conversion in the rabbit is not appreciably affected when the uterus is removed.

A. F. McKay, of Dalhousie University, working with Dr. R. D. H. Heard, continued investigations dealing with the degradation of cholesterol to Ring B substituted androgens, with the object of elucidating the structure of certain isomers of androsterone excreted during pregnancy in the mare.

Miss M. M. MacKenzie, of the University of Western Ontario, studied the relation of age of rats to susceptibility to cancer induced by benzanthracene. She found younger rats more susceptible than older ones, but the strain of the rat was found to be much more important than its age or sex.

Miss D. B. Mundell, of the University of Toronto, has devised a simple method for the purification of tissue cholinesterase from dog pancreas. One milligram of the purified esterase hydrolyses 4–5 grams of acetylcholine per hour. This degree of purity is about 100 times greater than that obtained by Stedman.

Dr. L. T. Newman and Messrs. W. A. Ladd and J. H. L. Watson, of the University of Toronto, worked on several applications of the electron microscope to medical research. With Dr. D. Irwin, a study was made of the size of the particles of mine dust, and it was found that particles 0.03–0.20 microns in diameter were much more numerous in drilling than in blasting dust. With Dr. J. Craigie, School of Hygiene, University of Toronto, several hundred photomicrographs of vaccina virus, typhoid bacillus, rickettsia and bacteriophage were taken.

Miss H. M. Perry, of the University of Toronto, performed experiments which showed that the lessened carbohydrate stored in scorbutic conditions was due to inanition and not to the deficiency of vitamin C. A peculiar condition of fat storage in vitamin C deficiency was substantiated, but fatty or cirrhotic livers were not observed. Experiments also showed that the capillary fragility is not a good index for the clinical estimation of either vitamin C or P deficiency.

H. C. Read, of Dalhousie University, found that the X-zone of the adrenal glands of the mouse degenerate during pregnancy and will regenerate after pregnancy but that regeneration is delayed by lactation. In immature animals the X-zone can be made to disappear by injections of oestrone, testosterone, A.P.L. and P.M.S. hormones.

Dr. K. Sternbach, of the University of Toronto, tested the activity of 104 new compounds of the sulfanilamide type, prepared by Dr. Schnitzer, against meningococcus infection. Ten showed definite activity but no more than that of drugs already known. Of a smaller series of drugs prepared by Dr. Siebenmann, two were found which were as efficacious as sulfanilamide with regard to meningococcus infection and were decidedly less toxic. Dr. Sternbach has also obtained a method of infecting animals with gonococci, so that sulfanilamide compounds could be tested against this type of infection in animals.

Dr. P. G. Weil, of the Royal Victoria Hospital, Montreal, has made further studies with regard to the histamine content of blood and tissues in shock. He has also investigated the value of certain substitutes for whole fresh blood in the treatment of the condition.

The trustees wish to point out that in addition to financially assisting the above-described individual researches, the foundation gave a block grant, amounting to almost half the income of the foundation, to the Banting and Best Chair of Medical Research, University of Toronto.

The trustees wish to remind medical research workers in Canada that funds are available each year to financially assist individuals who submit problems which meet with the approval of the trustees. Meetings at which applications are considered are usually held in May, August and December.

V. E. HENDERSON

THE BANTING RESEARCH FOUNDATION,
TORONTO, CANADA

SPECIAL ARTICLES

THE EFFECT OF COLORED IONS ON THE PHOTO-INACTIVATION OF INVERTASE

AGULHON[1] showed that invertase is inactivated directly by ultraviolet light of wave-length shorter than 3022 Å, while longer wave-lengths have no effect. However, von Tappeiner[2] had shown that the addition of fluorescent dyes to solutions of invertase preparations sensitized the enzyme to the action of sunlight. It seems apparent from these experiments that the radiant energy absorbed by the dye is in some way transferred to the enzyme molecule where it inactivates the prosthetic group. However, the task of proposing a theory of actual mechanism of energy transfers of this type is greatly complicated by the polyatomic nature of the dye molecule, for at least two possibilities exist: (1) the free dye molecule might be activated by light and transfer energy to the enzyme molecule in a collision process; or, (2) the dye molecule and enzyme molecule might form a complex which absorbs light energy, inactivating the enzyme and possibly freeing the dye molecule which may then take part in further inactivations. In a detailed discussion of the available evidence Blum[3] favors the latter mechanism.

---

[1] H. Agulhon, *Compt. Rend. Acad. Sci.* (Paris), 152: 398, 1911; *ibid.*, 153: 979, 1911; *Ann. Inst. Pasteur*, 26: 38, 1912.

[2] H. von Tappeiner, *Ber.*, 36: 3035, 1903.

[3] H. F. Blum, "Photodynamic Action and Diseases Caused by Light," p. 82, Reinhold Publishing Corp., New York (1941).

It seemed desirable to attempt to find out whether some monatomic ion having a suitable absorption spectrum could be found which would sensitize invertase to the action of light; for here, presumably, the first of the above possibilities would not exist. In this paper are reported the results of a preliminary investigation of the effect of certain inorganic ions on the photo-inactivation of invertase.

The enzyme used in this study was a commercial preparation[4] labeled "invertase scales"; it had been obtained from bottom fermenting yeast and contained some melibiase. For each experiment 0.03 gm of this preparation was dissolved in 4 cc of distilled water containing 1 drop of 0.1 N HCl and the desired concentration of the inorganic salt. After the enzyme had completely dissolved, 2 cc of this solution were placed in a quartz test-tube for irradiation and 2 cc reserved as a control in a glass test-tube of the same dimensions, but wrapped in black paper. Both tubes were then placed at a distance of 10 cm from a glass enclosed Type H-3 General Electric mercury vapor lamp for a measured length of time. The solution in the quartz tube thus received the full radiation from the lamp, while the control in the glass tube was affected only by the heat radiated from the lamp.

Following irradiation, the enzyme solutions were brought to 25° C. and each thoroughly mixed with 10 cc of a 20 per cent. sucrose solution. The rates of inversion of sucrose at 25° C. were then followed simultaneously in the 20 centimeter tubes of two polarimeters.

TABLE I

EFFECT OF COLORED IONS ON THE PHOTO-SENSITIVITY OF INVERTASE

Experiment number	Ion concentration (Mg/cc)	Length of time irradiated (min.)	Degrees of rotation			
			Original	20 min.	40 min.	60 min.
1.	None	0	12.5	8.0	4.6	2.4
		15	12.5	8.0	4.8	2.5
2.	0.1 mg Cu^{++}/cc	0	12.5	6.0	1.25	0.8
		15	12.3	12.0	12.0	12.0
3.	0.1 mg Cu^{++}/cc	0	12.33	7.48	4.15	2.1
		8	12.35	8.12	5.93	3.75
4.	0.4 mg Cu^{++}/cc	0	11.5	9.0	8.4	....
		15	11.5	11.5	11.5	....
5.	0.1 mg Fe^{++}/cc	0	12.3	7.45	3.75	1.25
		15	12.3	7.45	3.80	1.25
6.	0.1 mg Ni^{++}/cc	0	12.1	7.48	3.75	1.20
		15	12.1	7.48	3.98	1.08
7.	0.1 mg Co^{++}/cc	0	12.0	7.47	3.80	2.0
		15	12.0	7.47	3.83	2.38
8.	0.11 mg UO_2^{++}/cc	0	11.25	10.25	10.18	....
		15	11.30	10.31	10.31	....

The results are shown in Table I, which contains in successive columns the number of the experiment, the ion concentration, the length of time of irradiation and degrees of rotation in the polarimeter at various times after mixing the enzyme solutions with sucrose. From the results of Experiment 1 in which no salts were added to the enzyme, it is seen that 15 minutes irradiation of the enzyme alone had no effect on the activity. Experiment 2 shows that, while 0.1 mg Cu^{++} (as $CuSO_4$) per cc has a negligible direct effect on invertase activity, 15 minutes irradiation of a mixture containing this concentration of Cu^{++} results in almost complete inactivation of the invertase. In a supplementary experiment similar inactivation was found to result from 15 minutes irradiation of a solution containing only 0.05 mg Cu^{++} per cc. Experiment 3 shows that an 8-minute period of irradiation of invertase in the presence of 0.1 mg Cu^{++} per cc results in only partial inactivation of the enzyme. Experiment 4 shows that 0.4 mg Cu^{++} per cc partially inactivates the enzyme even without radiation, while irradiation increases the extent of inactivation by this concentration of Cu^{++}.

Experiments 5, 6 and 7 show that the colored ions Fe^{+++}, Ni^{++} and Co^{+++} in concentrations of 0.1 mg per cc bring about negligible inactivations of invertase even when the solutions were irradiated. Uranyl ion as $UO_2(NO_3)_2$ containing 0.1 mg of uranium per cc almost completely inactivates the enzyme; irradiation in the presence of uranyl ion causes still further inactivation. In another experiment Ca^{++} was found to have no effect.

The results suggest that, in order to bring about a photo-inactivation, a monatomic ion must have first, a suitable absorption spectrum, and second, a means of transferring the absorbed energy to the enzyme molecule. It seems probable that the cupric and uranyl ions form complexes with the invertase which, themselves, are capable of absorbing energy and decomposing to form inactive material. It would appear that the other colored ions used were incapable of forming such complexes and were therefore ineffective. Further work will have to be done to elucidate further the mechanism of the reaction.

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THE OCCURRENCE OF FITS IN PYRIDOXINE DEFICIENT RATS

CHICK *et al.*[1] described fits of an epileptic nature in rats maintained on pyridoxine deficient diets for a period of four months or more. No such fits have been reported in this country, although thousands of pyridoxine deficient rats have been studied. In the laboratory of the Poultry Division, hundreds of pyridoxine deficient rats[2] were studied without the appearance of such epileptic-like fits. Recently, however, fits such as described[1] were observed. The fits occurred among pyridoxine deficient rats, each of which was fed 5 cc of water by stomach tube every 3 hours. After the second water feeding 5 out of 16 rats were observed to go into fits which lasted from a few seconds up to about 2 minutes. Others possibly went into fits but were not observed. Fits developed when the rats were startled by noise or were surprised by being suddenly picked up. Others were nervous but were not observed to go into convulsions. The rats had been on the pyridoxine deficient diet about 4 to 5 months.

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[4] From Wallerstein Laboratories, New York, N. Y.

[1] H. Chick, M. M. El Sadr and A. V. Worden, *Biochem. Jour.*, 34: 594, 1940.

Since there is a disturbance of water metabolism in human epilepsy[3] we repeated the experiment, but the fits did not recur. The rats were then exposed to the piercing sounds produced continuously by frequencies of 30 to 10,000 cycles after they had been given water by stomach tube, but the convulsions did not recur.

At about this time, fits were observed in pyridoxine deficient rats in the laboratory of the Vitab Corporation. They were few but in sufficient numbers to arouse interest. These rats were also given water by stomach tube without producing any fits.

After the rats were 6 to 8 months old, convulsions occurred spontaneously with increasing frequency. The convulsions were not alike, but they followed a definite pattern. They generally occurred when several rats were together in a can and frequently handled during the time when they were weighed or the vitamin doses fed. One rat in fits will generally set off other rats in convulsions. Without warning the rat will sometimes start convulsively forward in jerks similar to the hopping of a mechanical rat. Often the rat will paddle the air with its paws. The head is often jerked up into an upward tilt and the rats get up on their hind legs and paddle the air. Sometimes they get up so high on their hind legs that they lose their balance and tumble over backwards or on their sides. When paddling or fanning the air with their paws their ears will sometimes wiggle rapidly, appearing much like a fan without a handle. Sometimes their ears are pressed flat against the back of their necks. While rearing on their hind legs, they will often involuntarily hop in the air, sometimes jumping out of the can. The paddling of the air and the fanning of the ears seemed to be motivated from one source as though controllable by one switch. These involuntary hops gave the appearance of being motivated by a hidden spring in the rat resembling a hopping mechanical rat. Mild convulsions were generally limited to a few convulsive hops or a half minute's pawing of the air often accompanied by the wiggling of the ears. Severe convulsions lasted 2 to 3 minutes. A round drop of saliva sometimes involuntarily appeared at the mouth of the rat during a severe convulsion. After a severe convulsion, the rat would sit or lie perfectly still, sometimes holding the wire screen tightly in the front paws. During this period the rat seemed unconscious and did not react when touched. The only sign of life was the heaving in and out of the sides, the forward part of the rat's body slowly moving forward and backward in rhythm with the heaving in and out of the sides. Occasionally the rats lay on their sides with their legs outstretched as though dead. They came out of this coma-like condition without any apparent effort and scratched themselves behind the ears or washed their faces as though nothing had happened. Occasionally after they had regained consciousness they shook themselves, much like a dog just coming out of water.

Convulsions were never observed under 4½ months, and then only rarely. When they reached the age of 6 to 8 months they occurred more frequently. Some rats had fits daily. The duration of the convulsions gradually increased. Out of 13 rats 7 months of age, 6 regularly had fits. Out of 3 rats 9 months of age receiving 5 micrograms daily of pyridoxine, one occasionally had a short mild convulsion.

We can, therefore, confirm the findings of Chick *et al.*[1] that fits will occur in pyridoxine deficient rats and we wish to suggest the possibility, remote though it may be, that disturbed water metabolism may in some way be involved in the production of these epileptic-like fits.

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---

[2] S. Lepkovsky, *Jour. Biol. Chem.*, 124: 125, 1938.

[3] C. H. Best and N. B. Taylor, "The Physiological Basis of Medical Practice," p. 1460. Baltimore: Williams and Wilkins Company. 1940.

EFFECT OF l-ASCORBIC ACID ON THE ISOLATED FROG HEART[1]

SIMPLE unsaturated lactones like $\beta\gamma$-angelicalactone, $\alpha\beta$-angelicalactone and crotonolactone γ-acetic acid and its esters have a characteristic digitalis-like action upon the frog heart isolated according to the method of Straub. If administered in an adequate concentration and replaced continuously (by means of a special cannula) at a steady rate for a suitable length of time,

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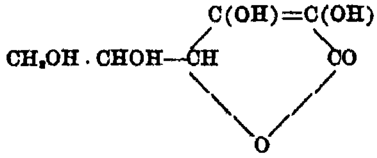
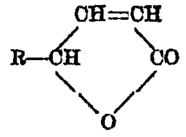
[1] Carried out under the auspices of the University Committee on Pharmacotherapy.

they initially bring about an increase in the amplitude of contraction and eventually lead to an irreversible systolic standstill.[2]

l-Ascorbic acid[3] (I) can be considered as an αβ-unsaturated lactone related in structure to the simple αβ-unsaturated lactones of type (II).



(I)



(II)

When administered into the cannula of the isolated frog heart at an initial concentration of 1:2,000 to 1:50,000 and replaced continuously at a rate of 2–2.5 cc per minute, l-ascorbic acid caused a systolic standstill within a period of from 2 to 5 hours. There was an increase in the rate of the heart. When the ventricle eventually stopped in systole, the auricle continued beating. The initial action of l-ascorbic acid was an increase in the amplitude of contraction. This was observed previously by Urban and Peugnet.[4] They also noted an increase in the diastolic "tonus" but were unable to reproduce this effect consistently.

Our preliminary work indicates that the reaction may be modified by the pH of the physiological salt solution. We have not yet studied how the systolic action is influenced by copper, which Peugnet[5] has found essential for the "beat-strengthening action" of l-ascorbic acid.

Our observations show for the first time that the reported "systolic" action upon the frog heart can be caused by an organic-physiological substance of known chemical structure occurring in the organism of the warm-blooded animal.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE STERILE CULTURE OF PARAMECIUM MULTIMICRONUCLEATA

DURING the last few years protozoologists have recognized more and more the need for sterile culture methods. When it is impossible to culture an organism in the absence of other living cells the rigid control of conditions so necessary in all experimental studies is not possible. Advances in methods of sterile culture of free-living forms offer new possibilities for similar studies on related pathogenic forms.

The establishment and culture of a strain of *Paramecium* that is bacteriologically sterile has frequently been attempted. The only successful cases that have been reported are those of Loefer[1] and Glaser and Coria,[2] in each of which the presence of other living cells was essential. We have established five strains of *P. multimicronucleata* in a yeast juice medium. These strains have been maintained for ten months through 18 transfers. Their sterility has been confirmed, so we wish to report the method used.

The paramecia were obtained from a live yeast stock culture which has been growing in our laboratory since 1937. The organisms were sterilized by a combination of the Claff[3] migration-dilution technique and the Parpart[4] washing technique.

Many kinds of culture media were tried, including peptone media, yeast extracts, yeast autolysates and unheated disintegrated bacteria, all with and without added growth factors. Success was attained only with the pressed yeast juice of Buchner.[5]

The pressed yeast juice is made as follows. One pound of Fleischmann's baker's yeast is ground with an equal weight of washed, fine, white sand. This is then mixed with 125 gms of diatomaceous earth and reground to a sticky dough. This dough is wrapped in two layers of birdseye diaper cloth, which has been dampened with distilled water, and then placed in a 4½" perforated screw press cylinder. Pressure, by a manually operated screw press,[6] is applied as rapidly as possible.

---

[2] O. Krayer, R. Mendez, E. Moisset de Espanés and R. P. Linstead, *Jour. Pharmacol. and Exper. Therap.* In press.

[3] l-Ascorbic acid was donated by Hoffmann-La Roche, Inc., Nutley, N. J., and by Merck and Company, Inc., Rahway, N. J.

[4] F. Urban and H. B. Peugnet, *Am. Jour. Physiol.*, 123: 207, 1938.

[5] H. B. Peugnet, SCIENCE, 90: 162, 1939.

[1] J. B. Loefer, *Jour. Exp. Zool.*, 72: 387–407, 1936.

[2] R. W. Glaser and N. A. Coria, *Am. Jour. Hyg.*, 21: 111–121, 1935.

[3] C. L. Claff, *Physiol. Zool.*, 13: 334–341, 1940.

[4] A. K. Parpart, *Biol. Bull.*, 55: 113–120, 1928.

[5] E. Buchner, H. Buchner and M. Hahn, "Die Zymasegärung," pp. 58–66. Münschen and Berlin: R. Oldenbourg. 1903.

[6] A "ten-ton" press made by the Atlas Press Company of Kalamazoo, Michigan, is used.

This procedure yields about 120 cc of yeast juice which is caught in an ice-packed flask and then stored in a refrigerator over night. It is then forced through a Seitz bacteriological filter by pressure. This juice is stored in a refrigerator at all times and is used only after complete sterility tests have been made.

For cultures, 5 cc portions of triple distilled water are sterilized in 18 mm Pyrex culture tubes, and, after cooling, 0.5 cc of the yeast juice is added to each aseptically. These are then ready for inoculation. Tests with a wide range of dilutions indicated that 1 : 10 is near the optimal concentration.

In all, sixty-one cultures of yeast juice were inoculated with sterile paramecia. From these, five strains were established and successfully maintained. Transfers are made at about 14-day intervals. Sterility tests have been made regularly at every transfer. Most of the common test media have been tried at various times in these tests. The standard testing media now employed consist of: 0.5 per cent. Difco yeast extract plus 0.5 per cent. dextrose; 0.03 per cent. beef extract; Difco nutrient agar plus 0.5 per cent. dextrose; and Brewer's thioglycollate anaerobic medium. Dr. C. B. van Niel,[7] of the Hopkins Marine Station, has examined several of these cultures and has confirmed their sterility.

So far it has not been possible to obtain in these sterile cultures a rate of growth equal to the highest rates obtainable in pure-mixed cultures of *Paramecium* and single strains of bacteria. The best fission rate obtained in these cultures to date is approximately 0.5 divisions per day. Fission rates of 1.0–2.0 per day have been reported for pure-mixed cultures. Heated yeast juice will not support the growth of *Paramecium*. Some factor or factors necessary for their growth is apparently destroyed by heat. This is in line with other observations which have been made on *Paramecium* and other ciliates. Most of the normally holozoic forms that have been studied will not grow when furnished with heat-killed organisms or with the ordinary heat-treated culture media as their only source of food.

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[7] We wish to express our appreciation to Dr. C. B. van Niel for first suggesting yeast juice as a possible medium, and for making sterility tests of our cultures.

THE SIGNIFICANCE OF FIBRINOLYSIS IN THE MECHANISM OF COAGULATION OF BLOOD[1]

WHEN recalcified dog's plasma is shaken briefly with chloroform and allowed to stand 24 hours, and the chloroform thereafter removed, the serum so obtained shows marked fibrinolytic properties. The properties of this so-called chloroform serum will be reported elsewhere.[2]

The precipitate of globulin obtained from this chloroform serum by isoelectric precipitation at pH 6 is soluble in isotonic saline solution. This solution of globulin possesses marked fibrinolytic properties.

The addition of small amounts to a solution of fibrinogen produces no clot but complete lysis of the fibrinogen. In the presence of prothrombin, however, a clot forms which may undergo fibrinolysis. The addition of the globulin solution to oxalated plasma results in coagulation sometimes followed by fibrinolysis. The addition of the globulin solution to prothrombin results in the formation of thrombin in the absence of calcium, thromboplastin or formed blood elements. In its action on blood plasma and fibrinogen the globulin solution resembles the action of trypsin as reported by Eagle and Harris.[3]

The active globulin solution may also be prepared by dialysis of chloroform serum against running water. In this preparation the active fibrinolytic substance is associated with the euglobulin precipitate. The solution in isotonic saline of this precipitate behaves as does the isotonic saline solution of the acid precipitated globulin.

It is to be noted that the methods of precipitation and dialysis are similar to those used in the preparation of "globulin substance" by Patek and Taylor.[4]

HENRY J. TAGNON[5]

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[1] From the New York Hospital and the Department of Medicine, Cornell University Medical College, New York, N. Y.

[2] Henry J. Tagnon, *Jour. of Lab. Clin. Med.*, in press.

[3] H. Eagle and T. N. Harris, *Jour. Gen. Phys.*, 20: 543, 1937.

[4] A. J. Patek, Jr., and F. H. L. Taylor, *Jour. Clin. Invest.*, 16: 113, 1937.

[5] Graduate fellow of the Belgian American Educational Foundation.

BOOKS RECEIVED

Advances in Enzymology. F. F. NORD and C. H. WERKMAN, editors. Volume II. 23 illustrations. Pp. viii + 374. Interscience. $5.50.

HARTKEMEIER, HARRY PELLE. *Principles of Punch-Card Machine Operation.* Illustrated. Pp. xiv + 269. Crowell. $3.25.

HOU, TE-PANG. *Manufacture of Soda.* American Chemical Society Monograph Series, number 65. Second edition. 149 illustrations. Pp. xviii + 590. Reinhold. $9.50.

LAURIE, ALEX and VICTOR E. RIES. *Floriculture.* Illustrated. Pp. vii + 496. McGraw-Hill. $4.00.

MUELLER-DEHAM, ALBERT and S. MILTON RABISON. *Internal Medicine in Old Age.* Pp. ix + 396. Williams and Wilkins. $5.50.

Science and World Order. The British Association for the Advancement of Science, report. Pp. 120.

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VITAMINS IN THE FUTURE[1]

By Dr. ROBERT R. WILLIAMS

CHEMICAL DIRECTOR OF THE BELL TELEPHONE LABORATORIES, NEW YORK, N. Y.

AMONG the dusty reprints which I treasure is a yellow-backed one from the *Journal of Physiology* bearing the date of December, 1911, in which Casimir Funk first proposed the name "vitamine." As I had at that time been working with Vedder for more than a year on "the beriberi-preventing substance," I may, in a sense, claim to have been one of the midwives in attendance at that historic birth. Vedder and I were among the first, if not the first, authors to take up the use of the term in our first joint paper, published somewhat belatedly in 1913. In 1916 my testimony in refutation of the claims of the manufacturer of a cure-all was part of the first court record in which the term appeared. As the years have overtaken my plodding feet, the number of scientific papers which employ the word "vitamin" has grown from a paltry two or three to some thousands annually.

I have recently been reading some medical biographies and particularly Clapesattle's story of the Mayos. There one notes that, although Pasteur indicted the atmosphere as a source of infective organisms in 1864, although Lister announced his method of antiseptic surgery in 1867 and had achieved international acclaim for his work by 1879, Will Mayo appears to have graduated in medicine at Michigan in 1883 with only a superficial knowledge of Listerism and scant conviction of its merits. It was not till four years later that he became a thorough convert, as were the majority of new medical graduates from that time onward. It had taken nearly twenty years for Listerism to gather momentum, but it then revolutionized surgery in a decade. It made deep surgery, especially abdominal surgery, possible. We are now in the midst of a like development of what may be called vitaminism, a development which is the more conspicuous because much of its content is appropriate to the use of the layman as well as the physician. The progress of its application has likewise been slow till recently but is now greatly accelerated.

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[1] Address on the occasion of the presentation of the Charles Frederick Chandler Medal of Columbia University, February 26, 1942.

May I ask you to consider with me some of those more immediate applications of vitaminism which we can discern are already beginning but which will require many years for full realization. It will be appropriate if I leave to my fellow medalist the role of longer range prophecy, for he will presumably live longer to enjoy the later triumphs of vitaminism, as well as to regret his prophetic errors if he should make such.

There are six vitamins which have already acquired an importance for the workaday world, for the layman, for the food technologist and for the practicing physician. By their lack ye shall know them. Five of the six are commemorated in the existence of ancient and wide-spread diseases which are known by household names in all the principal tongues of the earth. Perhaps the oldest of these diseases is beriberi, due primarily to a lack of thiamin. The earliest supposed reference to the malady is attributed to Hwangti, who adorned the medical profession about 2700 B.C. Scurvy ranks next in antiquity, for it was recognizably described by Hippocrates, the father of western medicine, about 400 B.C. and was the scourge of medieval armies and of the seamen of the age of exploration. The Englishman, long famed as a sailor, is still called a lime-juicer for his judicious use of this source of vitamin C. Rickets once had an association with England also. It was called the English disease because it was first described in 1650 by the Englishman Glisson, though it probably occurred earlier, as has been inferred from the rachitic appearance of children in German paintings of the fifteenth and sixteenth centuries. The virtue of cod liver oil in its treatment we now ascribe to vitamin D.

Pellagra seems definitely a product of the New World and has had an intimate association with maize, the New World cereal. Pellagra was noted first in American Indians about 1600 and almost simultaneously in Italian peasants who used maize as food. For a year or two now we have known that among the cereals maize is conspicuously low in nicotinic acid, only recently recognized as the anti-pellagra vitamin.

Lack of vitamin A is widely associated with a dryness of the eyes and also with night blindness occurring in many lands. The latter has been recognized in such widely separated areas as India, Japan and Newfoundland. It has occurred among Australian cattle. It has, however, belonged primarily to popular lore rather than to official medicine, which long hesitated to rate it as a definite entity. In Eber's papyrus about 1500 B.C. is the statement, "Because the unknown disease was cured by the roast liver of an ox, the disease was supposed to be night blindness."

Only one of the six vitamins which I have mentioned as important in a workaday sense lacks the monument of a well-defined long-known disease. I refer to riboflavin. The disease due to its absence in the food has no vernacular name and reflects its modernity in the term "ariboflavinosis." Some of its symptoms, notably fissures in the corners of the mouth, have often been noted in association with pellagra with which ariboflavinosis has been confused until within the past three years. Ariboflavinosis causes burning and redness of the eyes and may in extreme cases lead to alterations of the cornea and ultimately blindness. In young rats cataract can readily be induced by this deficiency. In man, however, the symptoms are but rarely severe, though they are frequently encountered among poorly nourished people.

From the fact that five of the six vitamins of present-day practical importance have left their traces in the records of centuries of history, one is tempted to classify the remaining vitamins as lesser ones and even to predict that the vitamins which are yet to be discovered are destined to have a progressively lesser significance for human welfare. At best such a prediction can be true only in the sense that the later vitamins will less frequently be found missing in widely used human dietaries. Even in this sense, exceptions may appear, for there remain well-known but obscure diseases, such as epidemic dropsy and sprue, which seem clearly to have dietary causes. On the whole, however, I think we may say that we have already discovered and produced commercially the vitamins which are required to check the great nutritional plagues of mankind.

Clearly this statement should not be construed to mean that the other vitamins play less essential roles in human physiology. Choline, pyridoxine, pantothenic acid, biotin, inositol, para amino benzoic acid and folic acid may and in most cases probably do perform equally essential functions for the human organism. A gross lack of any one of them might lead to a disturbance as pronounced as that of beriberi or pellagra. But it does seem true that the statistical probability of these lacks in human diets is less, else we should have encountered them historically. The lesser vitamins, if we may call them such for the sake of brevity, may afford us, however, great revelations regarding physiological and even pathological processes and so must be classified as lesser only in a narrowly defined sense.

My point in distinguishing between the major and the lesser vitamins is not one which primarily concerns the future of research. It is one which concerns present-day technology, present-day economics and present-day sociology. I should like to divert the minds of food processors, teachers of nutrition, practicing physicians and laymen from speculating about the latest surmise of vitamin science and persuade them to devote their major energies to the intelligent application of the vitamins which stand in the front row on the shelf. Since the number of vitamins has multiplied in mystifying confusion, the public taste turns to the newest one as the ladies' eyes turn toward the spring hats. The attraction for the latest novelty hardly surpasses that for gruesome details of symptomatology and pathology. We have popular lectures, even radio programs, on nutrition, which abound in the sordid details of ascites, neuropathies and cirrhoses, all of which is morbid and relatively unprofitable for the layman.

It is high time we should be systematically eradicating the long-known deficiency diseases. What has been done so far in that direction is with few exceptions little and local. Infantile scurvy and rickets have been distinctly diminished among the well-to-do and even the middle classes by increasing use of orange juice and cod liver oil for nursing infants. Happily women increasingly call on the doctor to attend them during confinement and the babies benefit from his advice incidentally at least during their early months. It is socially significant that babies are helpless and can not reject the mother's ministrations. They have accordingly benefited most systematically from nutritional advance. This, however, does not endure long and as the child grows older he is increasingly free to follow the prevalent nutritional abuses of his elders.

There are some aspects of nutrition in which we must continue to rely primarily on the educational process. Good foods must be chosen with reasonable regard to their supplementary relationships. Milk, meats, eggs, green vegetables and fruits need to be used in fair proportion to potatoes, cereals and sugar. Even the careless cookery can seriously mar not only the palatability but also the dietary values of the products. In our present society, care in these particulars must be supplied by the housewife who will continue to need no little instruction, especially if her husband's pocketbook restricts her choices.

We should, however, rely as little as possible upon the uncertain discernment, diligence and discipline of the housewife. Securing good nutrition by volitional choices, especially under economic, geographic and often nationalistic restrictions, often involves an amount of scientific knowledge which can not yet be imparted to the rank and file of working people. When our forebears lived in a state of nature, they got great protection from the fact that they ate things whole, even whole carcasses, and thus got a wide assortment of the chemical substances present in and necessary to all forms of life. Moreover, they had no great staples grown in broad cultivated fields. They pieced out their needs from the intermingled plants of the forest and field and from the animal life that scurried or crawled or swam within the range of their habitat. Diversity was forced upon them. But as husbandry came, there was increasing temptation to subsist largely on that staple food which was produced with the least labor and the greatest assurance. The one-sidedness of these diets was later further aggravated by refining processes applied to the great staples, such as rice, wheat and latterly sugar. Both diversity and wholeness were lost except for the more luxuriously fed segments of mankind.

The first impulsion of our present knowledge of vitamins and their essential roles should be to promote restoration of values lost to the masses by these restrictions. A general removal of economic restraints would largely achieve the result because appetites lead to diversity when income permits. This, however, is a Utopian ideal far beyond our immediate reach. Education, if universal, would largely accomplish the result, for avoidance of refinement is not inherently costly. However, education of the most needy elements is exceedingly slow and difficult. We must, therefore, turn to more effective weapons as soon as education has pervaded the public mind sufficiently to permit their employment.

Legislation is a possible weapon, but considerable public education must precede it. A bill to put a tax on white rice in order to discourage its use was first introduced into the Philippine legislature in 1911. Although it has since been reintroduced several times, it has never succeeded of passage. As a result incapacitation from beriberi is substantially as prevalent as it was thirty years ago, though we have known all that time how it could be prevented. The same condition prevails generally through the rice-eating areas of the Orient. There is apparently nothing prohibitively difficult about handling undermilled rice commercially, for I am told that Cuba prefers its rice in that form and gets nothing else.

Legislation in the United States prohibiting the sale of impoverished white bread and flour is a possibility. Undoubtedly any attempt to prohibit the sale of white wheat products in the United States would meet with insuperable public opposition. However, it is now possible to add artificially the principal valuable vitamins and minerals of wheat at a cost of something less than twenty-five cents per capita per annum. Increased economic productivity of the bulk of the population would repay the cost perhaps a thousand-fold to say nothing of improved health and sense of well-being. Yet this great reform is being sabotaged or damned with faint praise by half the nutritionists of the country on the ground that it would be still better if we could arrange breakfasts of ham and eggs, whole wheat buns and a glass of milk for everybody. Of course it would, but shall we wait for the millennium to take our first steps to mass repair of our nutritional errors?

Our present pure food legislation does not provide for such regulation of bread and flour. Our food law was aimed at the elimination of poisonous preservatives and the eradication of false statements of quality or identity. It assumed that our traditional and unsophisticated foods were wholesome and does not concern itself directly with their nutritional values. This must presently be changed so that the character of our available staples shall provide automatic protection against gross malnutrition when these staples are consumed in customary proportions and forms.

Pending the day when such legislation can be secured and the necessary scientific methods of control are developed, we must look largely to the food industries for correction of our dietary faults. These industries have been made very conscious of their public obligations, to a great extent through the operation of the pure food laws during recent decades. Within the limits of practicality, they are in general ready to cooperate in such reforms on a voluntary basis. Such an undertaking is the great program for the enrichment of bread and flour which began last May under the auspices of the National Research Council, the Federal Security Agency and particularly its subordinate unit, the Food and Drug Administration. As the addition of vitamins and minerals to bread and flour adds a few per cent. to the cost of production, a considerable public consciousness of the values it provides is essential to the maintenance and extension of the practice in these highly competitive industries. Further public education is necessary, a task which has been rendered difficult by rival advocacies by nutritionists of whole wheat or of other desirable nutritional reforms. It can not be claimed that enriched bread and enriched flour will correct all the nutritional faults of the nation. It is claimed, however, that this reform is incomparably more important than any other which is feasible of accomplishment within a decade.

There are some other staples which deserve analogous treatment. Addition of vitamin A to oleomargarine and of vitamin D to milk are such worthy projects. Iodized salt is another and there is much to be said for the increments of calcium which self-rising flour and baking powder furnish to the South, especially in areas where the milk supply is low. Because of the extensive occurrence of pellagra among maize eaters, addition of nicotinic acid to corn meal is under consideration. There is no sufficient evidence that rectification of staples should go further than this now. Vitamin C is sometimes too meagerly supplied, but there appears to be no other vehicle so effective as the increased use of fresh fruits and vegetables.

Riboflavin presents a rather peculiar problem. A partial deficiency of it is wide-spread, but we can not definitely lay the blame on any recently introduced food process or new alteration of habit. We need more extensive and more reliable assays of the riboflavin contents of foods. Light destroys this vitamin rapidly and this may be significant during manufacturing and distribution of certain foods. Milk is an excellent prophylactic when available. In normal times there is an enormous amount of skim milk, rich in riboflavin, which is never recovered in dry form or which is devoted to poultry feeds. The principal human use of skim milk powder is in bakery breads.

These and kindred problems of the conservation of the outstanding nutrient components of foodstuffs as related to variety, soil, climate, cultivation, transportation, storage, drying and canning of foods will furnish an enormous grist of work for the food industry laboratories for many years. Only recently have rapid assay methods for the principal vitamins begun to be available for the guidance of such studies. So long as the industries were dependent on laborious and sometimes uncertain animal experiments, progress was necessarily slow. Nowadays the food industry laboratories are turning out vitamin assays in great volume and with increasing precision. In general, these laboratories are able to select their samples for analysis with a far better perspective of the origin, classification, processing and destination of the products than is possible for the academic or government laboratory. Every laboratory performing such analyses should feel an obligation to publish its results for the public good or better still to contribute the analyses toward compilations which are almost constantly in progress in government bureaus.

When such nutritional reforms have been in full operation for some years, the physician will have little occasion to treat deficiencies of the major vitamins. Until that happy day, which must be some years hence, he will encounter an abundance of avitaminoses, especially in clinics for the under-privileged. His immediate task is to recognize the symptoms. If they are mild or mixed, this is usually beyond the average physician of to-day. An increasing number of younger men, however, are well schooled in their recognition and a host of laboratory methods for confirmation of diagnosis are in use or under development. They include principally optical methods for detection of eye lesions, mechanical tests of the fragility of capillaries and chemical analyses of blood, urine, breast milk and occasional biopsy specimens of tissue. Norms are gradually being established for each of these measurements; knowledge of the vitamin contents of each organ of the human body is slowly accumulating. These studies are not only of diagnostic value for guidance of treatment. They are peculiarly valuable for establishing optimal levels of daily intakes of each of the vitamins in food. Our earlier estimates of the desirable levels were often too low because they were based on findings for individuals then supposed to be normal but now recognized as sub-normal, so wide-spread are some of the deficiencies.

Many individual idiosyncrasies are encountered. Sometimes they may be due to the malfunction of a secretory organ, for example, the thyroid or pancreas. Obviously people suffering from organic disfunction are not immune to vitamin deficiencies. Intestinal sluggishness or hyperactivity often profoundly influences a vitamin economy. To judge from the findings in experimental animals, man's vitamin economy may be greatly affected by the organisms he harbors in his intestines. They may synthesize or destroy vitamins in quantity according to the strains present and the character of the milieu in which they live.

Fortunately for the physician in general practice who naturally can not keep pace with the manifold weekly developments of modern medicine, the therapeutic response of vitamin dosage is very often convincing. If it is not favorable, he may rest assured that he has done his patient no harm and proceed to the next indicated therapy. Often physicians resort to polyvitamin preparations. Knowledge of the nature of the deficiency is thus sacrificed, but the practice is at least in part justified by the fact that deficiencies are often multiple.

Six vitamins have been referred to as major ones. The physician, even in general practice, can not wholly afford to neglect some of the lesser ones. Notably pre-administration of vitamin K to prevent excessive bleeding in childbed is becoming routine in many hospitals.

You are doubtless asking what all this vitamin knowledge will get us in terms of health, strength and longevity. No quantitative estimates are possible. Very few long-term experiments with animals have been carried out since all the major vitamins became available in pure form and since several of the lesser ones have been at least recognized. There is much need for patient and thorough work along these lines. The testimony of the clinics, the results of experiments with school lunches or supplementary feeding, as well as the observation of health trends in nutrition-conscious populations, are very reassuring. Since partial deficiencies are often most apparent in middle or later life when the body mechanism is beginning to feel the strain of the years, it seems reasonable to hope that nutritional reform will extend the span of life measurably. Control of infectious diseases has principally affected mortality in infancy and early life. Those who survive to old age tend to be those who have acquired immunity to infectious disease or at least to have undergone a selection for resistance to disease. In nutritional disease, the phenomenon of immunity is absent. We do not grow accustomed to deficiencies with the years. Early damage remains and later damage accumulates till the slowing bloodstream of age leaves our cells grossly undernourished, so it seems.

I have dealt with what I believe we may do within some years in applying our present knowledge of vitamins to the problems of public health. I would not have you suppose, however, that my imaginative sensibilities are wholly dulled to the possibilities which future pioneering research may bring to light.

The chief product of our studies of vitaminism has perhaps been a knowledge of the nature and behavior of those once quite obscure or unknown substances. Major by-products have been techniques and philosophies.

Of techniques, there are many which have been provoked or promoted by the necessities of vitamin research. One may reflect that, had thiamin been isolated at the time its isolation was first seriously attempted, there was no one in all the world who could have made a competent elementary analysis with any available sample. It was the microanalytical techniques of Pregl and his successors which really gave usefulness to the isolation procedure. But to go back a step further, the isolation itself would have been impossible without an appreciation of adsorption and of hydrogen-ion control. Our knowledge and skill in these matters has been drawn from wide fields, from artificial catalysts, from gas mask construction, from the theory of solutions and the arts of the brewmaster. Yet the needs of vitamin chemistry have aided greatly in forcing a refinement of the methods and a sharpening of the tools. To go a step forward, had we succeeded in our isolation and obtained a significant analysis, we might well have been baffled for an explanation of the peculiar acid-base properties of thiamin had we no glass electrode to run a titration curve with precision, a device which depends for its excellence on recent advances in electrical arts. All this range of techniques has been brought to the service of biology in no small measure by the demands of the chemistry of minor organic constituents of living things.

And lastly of philosophy. We have long known there are enzymes and we recognized their analogy of function to the inorganic catalysts brought to light in great measure by Sabatier. The idea that a catalyst and its substrate must have a lock and key relationship arose early, based possibly upon Ehrlich's notions of immune reactions. Nobody, however, could prove the case, for the enzymes appeared to be gross and unmanageable molecules of great complexity. Turning to the inorganic catalysts for analogy did not help much because they obviously involved properties of the surface which were not shared by the interior of the particles. Precise chemistry of the surface, aside from the insides, was a poser. Even the electron microscope has its limitations in dealing with the irregular surface of a dense body.

It remained for vitamin chemistry to furnish the first example of an enzyme with a detachable prosthetic group, a key with the bit detachable from the stem. The bit or coenzyme turned out to be simple enough to be dealt with by classic methods of determining molecular structure; in fact it was a relatively simple derivative of a recently isolated vitamin. A similar relationship to enzymes has been proven for some other vitamins, though not all, and we know from the specificity of the coenzymes that the lock and key idea has validity. It is a notable step forward in enzyme chemistry and seems to offer an entering wedge for an attack on the chemistry even of genetics.

Another philosophy brought into relief by vitamin chemistry is the intimate chemical kinships of all forms of life. This permits the use of any convenient living thing to learn something about the probable behavior of more complex, delicate or unmanageable organisms, such as man. Vitaminism has taught us that metabolism is primarily cellular and not systemic.

It is true that these bits of philosophy are implications of vitamin chemistry and not necessarily integral parts of it. Nevertheless, vitamin chemistry will proudly observe their future progress, assured that presently we shall not attempt to distinguish sharply between vitamins and non-vitamins. That is an accident of the distribution of particular synthetic capacities among living things. We already know there is no sharp division along the borders of the animal and vegetable kingdoms.

VITAMINS IN THE FUTURE[1]

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THERE is an anecdote regarding the president of one of the smaller colleges who was induced to set aside a substantial fund for research. If my hearers can believe the first part of this story, namely, the alleged fact that a president of a smaller college actually found and set aside substantial funds for research, they will find no difficulty in believing the rest of it. It seems that the plea made to this president was that there were *questions* which needed to be answered and research offered the only promise of answers to these questions.

At length the money was spent and more was asked for. But after reading the report the president objected strenuously to an additional appropriation on the basis that while the original purpose of the research was to *answer* questions, the investigators had ended by *asking* more questions than they had answered.

It seems that nowhere has this principle been better exemplified than in the vitamin field. At first the question was asked and answered, "What are vitamins?" Secondly, skeptics challenged the chemist, "Show me *one!*" Parenthetically, I will say I am sure that the first time many people in this country saw a vitamin was when my big brother Bob went traipsing over the country under the auspices of Sigma Xi lecturing and carrying with him a huge bottle of pure crystalline thiamin. People really got an eyeful. I believe he doesn't have his big bottle of thiamin with him this evening. So many people are taking daily doses of it now that it has become unsafe for him to appear with it on the street for fear of being mobbed.

After one or two vitamins had been produced by the chemist, the clamor was "More! More!", and now the chemist is able to show to any skeptical individual about fourteen different, distinct vitamins in crystalline form. In addition, there are interchangeable forms of a number of the fat-soluble vitamins.

On this occasion we want to discuss a few of the questions regarding vitamins which are largely for the future to answer. These questions could never have been *asked* were it not for the knowledge already gained through extensive research. Some are questions of purely scientific interest. Many, however, have import from the standpoint of practical value to society.

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[1] Address on the occasion of the presentation of the Charles Frederick Chandler Medal of Columbia University, February 26, 1942.

Aside from the obvious question of what and how many vitamins exist, one of the most fundamental problems for the immediate future is to find out how vitamins act in the body—not what outward manifestations appear when they are lacking in the diet, but exactly how they function and why are they necessary. Each vitamin will present a more or less distinct answer to this question.

It appears that the "B vitamins," those comprising the group in which my brother and I have been primarily interested, are most fundamental to life. Living organisms are known (yeast is an example) which apparently can live and reproduce indefinitely without having in the cells at any time, so far as we know, any vitamin A, vitamin D or vitamin C. But in yeast and in other lower forms of life the "B vitamins" are, so far as we know, all present and functioning.

I was one of those who a few years back privately objected to jumping to the conclusion that since vitamins are present in tissues in small amounts they therefore are catalysts. It is now clear, however, with respect to several of the "B vitamins," that they do act as catalysts or at least are fundamental parts of catalytic systems. It seems not too dangerous now to infer that the other B vitamins probably act catalytically also. This conclusion does not follow necessarily for vitamin A, vitamin C and vitamin D. The functioning of these is very obscure at present.

We chemists have a simple device for representing a chemical reaction. If substance A is transformed into substance B, we write the formula of substance A, then draw an arrow pointing to the formula of the transformation product, substance B. The arrow indicates the transformation. Some one has defined a catalyst as something which "lubricates the arrow."

Vitamins of the "B group," we may conclude, probably act essentially as highly specialized lubricants for biochemical processes. In keeping with this idea they do not furnish energy but make possible its utilization. They do not function contrary to thermodynamics but make possible the flow of energy through the unbelievably intricate channels of living matter.

But we need a more intimate picture of how each of these vitamins act, what particular processes they lubricate and how they function. In the case of several of the B vitamins an excellent start has already been made; nicotinamide and riboflavin enter into indispensable "lubricants" for oxidative processes; thiamin is a part of a "lubricant" which is essential for decarboxylation mechanisms. However, our picture of why exactly these substances serve as "lubricants" is very hazy.

The case of pantothenic acid will illustrate our need for further knowledge. So far as we are able to tell, it is present in every type of living cell and we are led to assume that it catalyzes certain processes which are essential to life. There are facts which hint that it may be a lubricant for some step in the process of carbohydrate utilization. However, the subject of carbohydrate utilization has been studied extensively; many of the special "lubricants" have been identified and their action studied. Pantothenic acid, as yet, doesn't fit in anywhere in the scheme. So far as we can tell from its structure and chemical behavior it does not possess the properties necessary for an oxidation "lubricant." It doesn't appear to be adapted to receiving or donating hydrogen or electrons, and in this respect it is different from several of the other "B vitamins."

For a long time nutritionists have had some information regarding the functioning of vitamins. When a particular vitamin is lacking from the diet of an animal, it is usually possible to see that something is wrong. Often it is possible to identify the lack by the appearance or behavior of the animal, or the lesions which may appear on its body. When, for example, chicks are kept for a time on a diet relatively free from pantothenic acid, they develop what has become known as "chick dermatitis." But dermatitis, dermatosis or dermapathosis, if you like a more high-sounding word, simply means a diseased skin, and the trouble is much more deep-seated than this. Dermapathosis of one sort or another in one experimental animal or another may be caused by the lack of almost any member of the "B family" of vitamins. The symptoms may involve roughness or cracking of the skin in various areas, development of sores and loss of hair. Closely related is an unhealthy appearance of the hair or actual graying, since hair is a modified epidermal tissue. But in all cases the real trouble is probably not in the skin alone but in every tissue of the body. Naturally when we look at an animal we see the outside covering—the skin and fur. If there is something wrong with every tissue in the body of an animal, including the skin, we notice the skin and diagnose with a grunt of satisfaction—"dermatosis."

Studies made in our laboratory at Texas have showed that both in pantothenic acid deficiency and biotin deficiency not only the skin but every tissue and internal organ is lacking in the essential substance and shows its lack by failure to develop normally. If we were better pathologists we might be able to describe the changed morphology of the various internal tissues induced by the vitamin lack. I suspect, however, that the approach open to the pathologist would not always be a very fruitful one. A house infested with termites and about to fall down because of the weakness of the timbers could not be distinguished from a building having strong timbers, merely by photographic studies of its exterior. Just so it might not be feasible to distinguish morphologically between healthy cells from those which are deficient in some essential principle.

Physicians have coined the term avitaminosis to designate a diseased condition brought about by the lack of a vitamin. The various "avitaminoses" are poorly characterized indeed when we consider how many tissues may be affected. Superficial appearances and symptoms are wholly inadequate.

A question closely related to the one we have been discussing has to do with how the vitamins are interrelated. Each vitamin in general has been considered to have its individual independent function, and to be required as a separate entity for this reason.

There are some suggestive facts, particularly with regard to the "B vitamins," however, which cause one to be cautious and not too dogmatic. Several years ago we were studying the nutritional requirements of certain mold, and found much to our surprise that whereas it would not grow on a medium containing nothing more "special" than amino acids it would grow when to the medium was added thiamin, pantothenic acid, riboflavin *or* inositol. Growth would initiate when only one (not all four) was added. This observation should not be considered as a very valuable one so far as possible application to animals is concerned, because the mold in question was probably actually capable of synthesizing all four of the vitamins and required one of them only as an initial stimulus. In animals thiamin, pantothenic acid and riboflavin can not be synthesized (the case of inositol is uncertain) and one certainly can not replace another.

Another interesting and suggestive fact is that the various B vitamins are definitely associated together. Our recent studies of the vitamin content of tissues show a definite and often high positive correlation between the vitamin contents of different tissues. Those that are relatively rich in some of the "B vitamins," notably liver and kidney, have a tendency to be rich in all. Tissues such as skeletal muscle have a tendency to be low in all. Heart muscle, incidentally, is almost invariably richer in all B vitamins than skeletal muscle.

We have found also, for example, that feeding hens a diet enriched with respect to pantothenic acid causes the other "B vitamins" to be somewhat changed in their distribution in the chicks hatched from the eggs. This indicates that the different "B vitamins" are not working entirely independently.

The probability that one known vitamin can actually replace another can be pretty well ruled out on the basis of available evidence. We can not be sure, however, that our need for one is not influenced by our supply of another. It is well recognized, of course, that thiamin is essential for carbohydrate metabolism and that on a high fat diet less thiamin is required. If there are vitamins which are peculiarly essential to fat metabolism, it is easy to imagine that the amount of these in the diet might affect the thiamin requirement and *vice versa,* yet neither of the two vitamins would be capable of actually replacing the other.

With regard to amino acids, it had become customary to think of them as being in two groups—essential and non-essential—until Rose and his coworkers showed that arginine is not essential for growth but is essential for *rapid* growth in rats. It is one amino acid which can be built up in the bodies of rats but not with sufficient readiness to allow rapid growth. Is there any parallel in the field of vitamins? Are there vitamins which are not absolutely essential, but which are necessary if good performance is to be induced? One reason for thinking that this may be is the fact that in yeasts, for example, the phenomenon is observed again and again. Biotin, the remarkably potent yeast growth substance discovered by Kögl, is so far as I know not required for the growth of any of the yeasts which it stimulates. These yeasts will grow without biotin, and as they grow it is produced in abundance. But biotin is a powerful stimulant of yeast growth; it can not be produced by yeast readily enough to allow the most rapid multiplication. The most rapid multiplication takes place only when it is furnished in the culture medium.

Whether "non-essential" or "optional" vitamins occur which are effective in animal nutrition is a question for the future. It is entirely possible that some of the lesser known members of the "B family," the status of which is still in doubt, may belong in this category.

Another question arises naturally as a result of our work with microorganisms. Are there such things as "anti-vitamins" or inhibitory principles in foods which affect health and well-being? Of course the existence of a special protein "avidin" in raw egg white, which is capable of inactivating biotin, has been demonstrated, but I am thinking more particularly of low molecular weight compounds. In laboratory studies with microorganisms (yeasts particularly) we are constantly confronted with the presence in extracts of inhibitory substances which profoundly influence growth. We have long suspected that the same or similar substances may have an influence on mammalian nutrition, but very little is known about the existence or functioning of such substances.

A field of study which should be pointed out while we are mentioning microorganisms is that of the bacterial production of vitamins in the intestines of animals. Of course we must know to what extent this is being accomplished before we can have an adequate idea of how much of the vitamins are required in the food under different conditions. Elvehjem at Wisconsin and Mitchell at Texas have made recent studies of this problem, but I must not tarry on this particular phase of the subject.

I must turn now to a discussion of some of the possible applications of the new knowledge which I believe will be forthcoming. One of the subjects which has been of particular interest to me is that of *individual differences. Vitamin study has not in general been concerned with this at all.* Every attempt has been made in dealing with experimental animals to have them as uniform as possible so they will give the same responses. By careful inbreeding and use of litter mates for controls much has been accomplished in this direction, but even so it is still necessary to use a number of animals if one is to perform a conclusive experiment. This merely means that irregularities of response are to be expected.

How great a contrast is there, biologically speaking, between an inbred colony of experimental animals and, say, the population of New York City, where even within each of the numerous racial groups there are tremendous genetic differences. But our nutritional knowledge when applied must be used in precisely such diverse groups. It may be that some day the medical profession will be able to concentrate its attention upon the very thing that the nutritionist likes to eliminate as completely as possible, namely, the variation in the needs of individuals. There are two convincing arguments in favor of the therapeutic use of vitamins: one is that they *work* and the other is that their use is rational in view of the existence of individual differences and exaggerated requirements which may not be met by ordinary foods. Not only the heritage of an individual but his case history may conceivably make for altered and probably increased vitamin requirements.

We know that the chemistry of our individual bodies is not all exactly the same, otherwise a bloodhound could not use his nose to distinguish between individuals. It is a well-known fact, though not always recognized in practice, that individuals do not all respond alike to common drugs. I once had a student who had his tonsils removed almost without an anesthetic, because the operating physician could not believe that he was unaffected by novocaine, even though the fact had been demonstrated previous to this occasion. Curious individual peculiarities sometimes show themselves. I have an acquaintance who, though his sense of smell is normal in all other known respects, is unable to detect the odor of a skunk. For him, the pure substance n-butyl mercaptan, the active principle of "skunk perfume," has no striking or obnoxious odor. When such remarkable differences exist with respect to other chemical substances it would not be surprising if the vitamin requirements of some individuals deviated sharply from the mean. Virtually nothing is known at present regarding this possibility.

Another field where vitamin study will doubtless find fundamental applications is in chemotherapy. Not many years ago chemotherapy was considered almost a dead issue, with salvarsan and its relatives as the outstanding achievement. In recent years with the advent of sulfanilamide and its relatives chemotherapy is riding the crest of the wave and is more important than ever before.

While the action of drugs is never simple, there can be no reasonable question but that sulfanilamide and related drugs owe their action at least in part to their structural similarity to a vitamin, *p*-amino benzoic acid. It has been demonstrated that sulfanilamide inhibits bacterial growth *in vitro* by blocking out *p*-amino benzoic acid, and that its effects can be neutralized by the presence of an excess of *p*-amino benzoic acid.

Snell at the University of Texas has shown that the sulfonic acid analog of pantothenic acid inhibits the growth of bacteria which require it, and that its effect can be neutralized by additional amounts of pantothenic acid in an exactly analogous fashion.

These facts appear to be the basis for an entirely new approach to chemotherapy. It seems a reasonable working hypothesis to assume that chemical substances which have striking physiological effects have these effects because of their resemblance to naturally occurring tissue constituents, and that many substances of potential therapeutic value will be found which bear chemical resemblances to the various vitamins, of which we now have a considerable variety. If these remarks are valid, chemotherapy can now develop, not in a hit-and-miss and entirely empirical fashion, but by making use of at least one definite guiding principle.

One of the most important applications of vitamin knowledge will be, I believe, to the study of cancer. About a year and a half ago we were enabled, by a generous grant from the Clayton Foundation of Houston, Texas, to start a study along this line.

We felt, and have had no occasion to alter our opinion, that any study of the interrelations between vitamins and cancer must be a thorough one, so that our work in this field is not narrowly confined to cancer as such but also to a better understanding of how vitamins act in normal tissues. We are cognizant of the fact that vitamins which are as yet undiscovered may play a role, so we are interested in these also.

Aside from the development of methods and the study of the vitamin content of tissues, my associates, Drs. Pollack and Taylor, are carrying forward a more systematic study than has ever yet been attempted of the effect of vitamins in the diet on the incidence and development of various types of malignant growth.

In a book from the Bar Harbor Laboratories, published late in 1941, appears the following statement:

> Various experimental, unbalanced and defective diets have been reported as influencing the number of ''takes'' and the rates of growth of transplanted tumors. There is no doubt that diet may play a part in determining the reaction of the animal. On the other hand, the fact that the investigators have not used inbred strains to reduce and control the genetic variables, leaves it uncertain as to the cause and effect relationship between diet and changes in percentage of growth. This fact, coupled with an almost complete disregard of criteria of mathematical significance between the groups that are being compared, seems to have left the problem of diet in a most unsatisfactory condition. For this reason no attempt is made in this volume to cover the extensive but non-critical bibliography. The whole problem will have to be approached ''from the ground up'' by investigators who understand and utilize genetics, biochemistry and mathematics.

We were pleased when we read this because it coincided with our ideas and we had in fact just planned extensive experiments along exactly the lines suggested. These experiments are now under way and the results will be reported in due time. There are various groups of workers interested in essentially the same problem. It has been demonstrated many times that diet and specific vitamins affect the incidence and development of cancers induced by feeding butter-yellow. Our work as well as that of others indicates that the vitamins in the diet make a difference in cancers other than those induced by butter-yellow. We can not say yet just what the total results of our rather comprehensive experiments will be, but we can already be sure of one thing. They will be interesting.

A pet thought of mine which it seems appropriate to mention on this occasion is that one of the most important borderline fields in the future will be that existing between biochemistry and psychology. In this particular field vitamins will probably play an interesting role.

We have noted in our laboratories "personality differences" developed in experimental animals apparently as a result of diet. I presume similar observations have been made elsewhere. It is well recognized that good health and good dispositions tend to go together, and in so far as an abundant supply of vitamins may foster good health it will also promote good psychological adjustments. The current view with regard to psychological disturbances is that they are essentially pathological and amenable to treatment just as other ills are. It is a truism that mental health is based upon bodily health, and there are some good reasons for thinking that vitamins may in the future contribute materially to mental health and to satisfactory psychological adjustments. It is recognized already that one vitamin can and does cure mental derangements. One of the most distressing symptoms of pellagra are the hallucinations, dreams and other mental symptoms. These are tremendously helped by nicotinic acid administration. People who were so "crazy" as to be totally incapacitated have been brought back to the point where they can perform the functions of a useful member of society. What other vitamins may do for mental ills is yet to be demonstrated.

It should be pointed out that good diets, which mean an abundant supply of vitamins, among other things, promote intellectual keenness as measured by psychological tests both on animals and human beings. There can be no doubt that much dullness on the part of school children, particularly among the lower income groups, can be traced in part to a lack of the proper kind of food and specifically to the lack of enough vitamins.

We may as well end this part of the discussion on as lofty a plane as possible. Recent studies, several of them in New York City, have shown without question that intelligence and morality go together. The more intelligent a child is the less is his tendency to cheat, lie, steal or become delinquent. This high correlation between intelligence and morality can lead us to one conclusion. Since an ample supply of vitamins can foster a higher intelligence in human subjects it has also the capability of fostering morality. Vitamins in the future will not only give people better health both bodily and mentally but will increase their intelligence and their morality. It remains for the future to show to what extent these ends can be accomplished and how useful vitamins will be as tools for their accomplishment.

OBITUARY

JACOB ELLSWORTH REIGHARD

AFTER an illness of some weeks, Professor Jacob Ellsworth Reighard died on the 13th of February, 1942, in his eighty-first year. Thus passed a leader in the field of ichthyology, fresh-water biology, animal behavior and evolution—a man whose biography would involve a considerable portion of the history of the department of zoology at the University of Michigan.

Born of Pennsylvania parents at LaPorte, Indiana, on July 2, 1861, trained at Michigan and at Harvard under E. L. Mark, and with a background of two years as a private tutor and one year of high-school teaching, this enterprising young zoologist returned to the University of Michigan as instructor in 1886. He was given the title professor of animal morphology in 1892, and professor of zoology, director of the zoological laboratory and director of the museum of zoology in 1895. His directorship of the museum was relinquished in 1913, and that of the zoological laboratory in 1925, though he continued as an active member of the staff until his retirement in 1928.

Professor Reighard's interests were varied through his lifetime, but the phases of his activities were rather sharply marked off from one another. He concentrated on one thing at a time. A chronological list of his publications would appear to indicate a considerable overlapping of these phases, but it would be deceptive because of delayed publication. A number of times in his career he published from data that had been in his files for many years. It was obvious to his colleagues that preparation of such delayed papers was to him a peculiarly onerous type of drudgery, to which he drove himself with a feeling that it was his duty to put his accumulated information on record.

His early investigations were on the embryology and morphology of fishes, which involved naturally the taxonomy of that group. From 1890 to 1895 he was in charge of the scientific work of the Michigan Fish Commission, and from 1898 to 1901 directed the Biological Survey of the Great Lakes conducted by the U. S. Fish Commission. Interest in fish led him to studies of plankton, originally as fish food but later as a component of fresh-water communities in general and as important material for investigation of fresh-water biology *per se*.

Difficulty with his eyes led Professor Reighard to abandon indoor, particularly microscopic, work and to take up outdoor studies. A notable feature of these new investigations was that they were performed with the same critical standards, the same meticulous attention to any detail which might later prove important, the same rigid requirements for sound judgments which had characterized his laboratory studies. Laboratory methods were being transported into nature, where they served as a model for a then relatively new type of outdoor work.

The field studies naturally revolved around fishes and were concerned largely with breeding behavior. Nest building and the courtship and other mating activities of a number of different fishes, and lampreys, were carefully observed. The heightened color of some fishes at the breeding season led Professor Reighard, with certain of his students, to a critical study, first, of the psychology of color vision in fishes, and later of the significance of color in evolution. Under the latter rubric comes his notable reexamination of the supposed warning color of brilliant small coral-reef fishes. In this study he showed that it was not the color of these fishes, but the presence of the reefs, which saved them from attack, and he was led to formulate the theory of immunity color to replace warning color in this particular situation. The coral-reef experiments were judged by eminent contemporaries to be the "most important experimental study of natural selection" (Pearl) and the "best work done at the Tortugas Laboratory" (Mayor) up to that time.

His teaching mostly concerned the vertebrate animals. Once his principal course was on vertebrate (with emphasis on mammalian) anatomy. As his interests changed to outdoor studies, his main course was called simply vertebrate zoology, which included habits as well as morphology. This was later transformed into natural history, which included some invertebrate fresh-water ecology. The field thus covered was unwieldy, and the invertebrate part was split off (eventually changing to limnology, given by others), while the vertebrate part continued as vertebrate natural history. On Professor Reighard's retirement, the latter course was taken over and developed by the late Professor F. N. Blanchard. For many years Professor Reighard gave also a semipopular course on evolution.

Late in his active life a growing deafness deprived Professor Reighard of many of the ordinary human contacts. He was stimulated to an effort to aid others similarly afflicted, and devoted much time to learning lip reading, to writing articles on the place of speech reading in schemes of education and to translating important foreign-language works in that field.

Mention should be made of one important service for which, in some circles, Professor Reighard was better known than for any other—the publication, with Herbert S. Jennings, of "The Anatomy of the Cat." This book was for many years the standard work for courses in vertebrate anatomy. Classes were small, however, and the book was never an important source of income for its authors, for it was many years after first publication that the senior author humorously displayed to his colleagues the first royalty check for a few dollars. In recent years, after a third of a century of use, this book has been revised by Dr. Rush Elliott in close cooperation with Professor Reighard and is again offered to students of mammalian anatomy.

Throughout his scientific career Professor Reighard showed keen interest in the invention and construction of technical apparatus for use in investigations. Photography was the outlet for much of this natural bent, and several publications on the technique of obtaining photographs of biological material resulted. One of these was devoted to underwater photography. In his plankton work he introduced the new European methods to America and made important improvements upon them by modifications of equipment. In the coral-reef studies he contrived an ingenious device for recording his observations without taking his eyes off the fish. When the Natural Science Building at the University of Michigan was built and equipped, his mechanical propensities found expression in the design of the photographic and preparation rooms and their apparatus.

Scientific organizations have felt the influence of Professor Reighard's career in no small measure. Locally he helped found the Michigan Academy of Science in 1895 and was one of its early presidents; he was one of two coinstigators of the founding of the Research Club of the university and appeared repeatedly on its programs, and was active in the Michigan chapter of Sigma Xi. He was largely responsible for the establishment of the university's biological station in northern Michigan in 1909, and was its director the first six years (though resident at the station only three of these). Beyond the university's immediate domain, he was president of the central branch of the American Society of Zoologists, president of the American Fisheries Society and vice-president and chairman of Section F of the American Association for the Advancement of Science; and he presided at two sessions of the section on animal behavior of the International Zoological Congress in Boston in 1907.

Professor Reighard was an outdoor man in recreational as well as scientific ways. Member of a local club having properties on a group of nearby lakes, he could frequently be found living for weeks at a time in its cottages. Journals of some of his camping trips with friends, and appended lists of equipment for the instruction of other campers, have been preserved among his papers. He was instrumental in forming a faculty club, with fencing, boxing and the broadsword as leading activities; but when this later led to the establishment of a university club with social functions, he gradually lost interest in it. Never an effusive person who made friends by sheer charm of manner, he was nevertheless one of a considerable group of loyal and devoted persons among whom there was genuine and strong affection—a fact well demonstrated at a testimonial dinner given him a year or so before his retirement, at which "Old Friends" participated to an important degree. His scientific attitude was one of rigorous discipline; nothing was proved, in his estimation, short of proof. In his middle and earlier years his colleagues may have felt his driving industry, but he drove himself more than he drove any of them.

The passing of Professor Reighard will be regarded as a milestone in the progress of some of his fields of interest, in which there have followed still greater developments than any attained in his time. In others his work must still be seen in retrospect as a model scarcely equaled since, and, hopefully, as a stimulus to further advance.

A. FRANKLIN SHULL

REMEMBERING WILLIAM JAMES

THE *Harvard Alumni Bulletin* calls attention to the fact that January 11, 1942, marked the hundredth anniversary of the birth of William James, American philosopher. The *Bulletin* states that weeks before the actual date, societies, libraries, university departments and colleges the country over began to celebrate —as they are still celebrating—this significant event. William James taught at Harvard from 1872 to 1907, retiring as professor of philosophy emeritus.

A conference on methods in philosophy and the sciences was held in New York City at the New School for Social Research on November 23, 1941. One of the symposium titles was "Remembering William James," and the five speakers included Henry James, '99, of the Corporation; Dickinson S. Miller, '92, and Professor John Dewey of Columbia. On December 29, 1941, at Vassar the forty-first annual meeting of the American Philosophical Association held a William James symposium. Two of the speakers were Harvard teachers: Professor Ralph Barton Perry and Associate Professor Donald C. Williams. A William James exhibition opened at Widener Library on January 2. At the Harvard Club of New York, the club library held a special exhibition during the month of January of "Books Annotated by Great Harvard Scholars," centering on a few books comprising the William James collection in the Harvard College Library.

Then a William James centennial program was given by the department of philosophy in the University of Wisconsin, January 10, largely arranged by Professor Max C. Otto of that university. At Norwich University, January 11, the department of philosophy and psychology held a meeting in commemoration of William James. Professor J. Seelye Bixler, president-elect of Colby College, spoke at Colby (January 17); at the same time an exhibition of letters of William James and his father, Henry James, was arranged at the Colby Library. Scripps College in California carried out a centennial program, January 11, of which William Bennett Munro, Ph.D., '00, of the California Institute of Technology (formerly a member of the Harvard faculty), was the honorary chairman. Professor William E. Hocking spoke on "William James' World-View."

Professor Hocking also opened a series of symposium lectures at Harvard, "William James and the Psychology of the Present," on January 28. Twelve men are contributing to the series, in which five lectures have already been given, with seven to come, concluding on April 22. In September the American Psychological Association will celebrate the James anniversary at Harvard, with James R. Angell, formerly president of Yale, as chairman.

RECENT DEATHS

EDWARD C. SCHMIDT, who retired two years ago as professor of railway engineering at the University of Illinois, died on March 21. He was sixty-seven years old.

DR. MARTHA TRACY, assistant director of the Public Health Department of Philadelphia, died on March 22, at the age of sixty-five years.

DR. GEORGE SHIRAS, 3D, of Marquette, Mich., known for his flashlight photographs of wild animals, died on March 24, at the age of eighty-three years. He had made biological expeditions to Newfoundland, Alaska, the West Indies, Mexico, Panama, Hawaii and the Rocky Mountains.

DR. I. SETH HIRSCH, since 1933 professor of radiology at the New York University College of Medicine and a practicing physician in New York City for forty years, died on March 24, at the age of sixty-one years.

THE death is announced of Professor Sir Robert Chapman, since 1939 president of the South Australian School of Mines.

SCIENTIFIC EVENTS

PHYSICIANS FOR THE GOVERNMENT SERVICES

IT is reported in *The New York Times* that at a meeting of the Medical Society of the County of New York at the New York Academy of Medicine, Colonel S. F. Seeley, of the Army Medical Corps and the executive officer for the Procurement and Assignment Service for Physicians, Dentists and Veterinarians, a branch of the Federal Security Agency headed by Paul V. McNutt, announced that a questionnaire will be sent to every physician, dentist and veterinarian in the United States during the first week in April by the Procurement and Assignment Service, Washington, "designed to give an opportunity to the 270,000 persons in these professions to state their preference, should they be called, whether in military, governmental, industrial or civil activity."

Colonel Seeley said:

> For the first time in history there is now to be concentrated in one office the data on the availability of professional men to supply the needs of the Army, Navy, U. S. Public Health Service, U. S. Civil Service Commission, Veterans Administration, U. S. Children's Bureau, physicians and dentists and veterinarians and other government services.
>
> No service will commission or employ a person unless cleared by this Procurement and Assignment Service. This immense mobilization must be accomplished without the least jeopardy to the communities from which the men are taken.
>
> The Navy will need a total of 3,000 doctors when its enlistment of 500,000 is reached. For the Army, 16,000 new physicians must be supplied by December 1.

Nearly two years ago the American Medical Association sent out a questionnaire and elicited replies from more than 159,000 physicians in the nation, of whom more than half were willing to volunteer for medical service in case of war. Of the 62,000 under the age of 45, 63 per cent. of the unmarried and 48 per cent. of those married even at that early date before war seemed probable, twenty-two months ago, were willing to offer their services.

Colonel Seeley stated further:

> Many physicians are especially interested in aviation medicine. Information blanks may be procured from the Office of the Air Surgeon, Army Air Force, Washington, D. C. Last week my office received a request for 2,500 medical officers for service with the Air Corps by July 1, and to provide 600 per month for the balance of the year. Of the men selected, 80 per cent. must be under 36 years, 20 per cent. may be selected from the group between 36 and 45 if they are recognized specialists, particularly in traumatic surgery, ophthalmology or neuropsychiatry.
>
> No man will be assigned to duty if he is essentially needed on the staff of a teaching institution, industrial plant, hospital staff, public health service or in private practice, unless he can be replaced. But it is expected that all such positions ultimately can be filled by men over forty-five years, or those physically unfit for service under that age, and by women doctors, of whom the nation now has 8,000 in active practice.

A NEW BOTANICAL HALL AT CARNEGIE MUSEUM

THE Carnegie Museum, Pittsburgh, according to *Museum News*, has transformed its Botanical Hall so completely as to make it a new hall both in installation and architectural design. Daylight has been eliminated by closing all the windows with solid stonework; an illusion of spaciousness has been given by a concave dome-like ceiling over an octagonal opening in a false ceiling, thus combining flat and concave effects. An effective system of ventilation has been added. The habitat groups now appear as openings in the walls of the gallery instead of as individual protruding boxes. The effect is a pleasing continuity. Reflections on the glass are eliminated by interior case lighting. Labels by Curator O. E. Jennings contain explanatory transparencies in color photography that enable the visitor to identify individual plants and the occasional animal forms introduced into the settings. Full-sized groups installed are the Florida group, the Pennsylvania bog, the spring flora of Pennsylvania, Mount Rainier and Arizona. Three additional full-sized groups are proposed, and the space left for these is now occupied by miniature dioramas showing Arctic tundra, the slope of Pennsylvania Laurel Ridge Mountain and Presque Isle Peninsula on Lake Erie. Other exhibits in the room include enlarged models of flowers and maps showing vegetational regions. An octagonal block of benches occupies the center. Plans are ready for two gallery floors and await only the necessary funds for work to begin. Frank A. Linder developed the plans and supervised construction of the Botanical Hall, which was a WPA project. Roy B. Ambrose, of the building staff, helped in the technical problems. Ottmar F. von Fuehrer, staff artist, created the exhibits with the help of Mrs. Fuehrer and Carl Beato, under the general direction of Mr. Jennings. For the Arizona group alone Mrs. von Fuehrer and Mr. Beato fashioned some 12,600 separate pieces.

THE HALL OF NORTH AMERICAN MAMMALS OF THE AMERICAN MUSEUM OF NATURAL HISTORY

AFTER six years of construction and preparation, the new hall of North American mammals in the American Museum of Natural History will be opened to the public on April 9. The first completed habitat groups (ten in number) of what is eventually expected to be the world's finest representation of North American animals housed in one exhibition hall, will be dedicated by officials of New York City and trustees of the museum on April 8.

The new hall is a panorama of wildlife throughout the entire continent, extending from Ellesmere Land, near the North Pole, to Mexico; and from New York State to the west coast of Alaska. As in the Akeley African Hall on the floor above, the animals are mounted in realistic life settings of their native plains, forests, swamps, mountains and deserts.

More than eighteen years ago, Dr. Harold E. Anthony, curator of the department of mammals, outlined plans for a new and modern hall of North American mammals to replace the old interpretation and "stuffed animal" appearance of exhibitions shown in the old mammal hall, built in 1890.

Realizing also that in many instances America's wildlife is still continuing to disappear before the advance of civilization as well as through changing climatic conditions governing the native habitats of these animals, F. Trubee Davison, president of the museum, since the summer of 1935 has directed its expedition program principally to the North American continent for extensive collections of our existing animals.

In 1937 Mr. Davison enlisted the active support of officials of New York City and those who wished to see American mammals preserved in life-like settings for future generations that may not have the opportunity of knowing the living animals.

Without funds contributed by the City of New York for the construction of cases, obtained through the efforts of Mayor Fiorello LaGuardia, Commissioner Joseph T. McGoldrick and Commissioner Robert Moses, the new hall could not have been built. Under the leadership of the Trustees' Committee of North American Mammals eighteen expeditions have collected for the ten habitat groups now completed and eight to be opened in the near future.

The designs, preparation and presentation of the groups were carried out by Dr. James L. Clark, head of the Department of Arts and Preparation, assisted by Albert E. Butler and under the scientific direction of Dr. Harold E. Anthony. Engineering and construction were in charge of Rex Johnson, general superintendent, assisted by Victor Ronfeldt, mechanical superintendent, and Wilson L. Todd, power plant engineer.

The animals were mounted by sculptor-taxidermists, Robert H. Rockwell, Gardell D. Christensen, George Adams and Waddy McFall. Artists who painted the background scenes, in most cases made from their own expedition field-paintings, were Belmore Browne, Charles S. Chapman, Carl Rungius, James Perry Wilson, Francis Lee Jaques, Joseph M. Guerry and Frederick Scherer.

Those who participated in the making of flora and foreground accessories were: Albert E. Butler, George E. Petersen, Raymond H. De Lucia, G. Frederick Mason, Ralph Mendez, Robert Scherer, Charles Tornell, Robert Sewell, Bernard Chapman, Rudolph Freund and James Carmel.

THE NATIONAL RESEARCH COUNCIL'S COMMITTEE ON THE APPLICATIONS OF THE ELECTRON MICROSCOPE

THE electron microscope has opened up for investigation a new order of submicroscope dimensions. Within this range are minute structures of interest in most, if not all, fields of natural science. Interpretation of electron micrographs involves new problems; these arise primarily from the complexities of the instrument itself and secondarily from the unfamiliar nature of the minute structures under study.

The National Research Council's Committee on Applications of the Electron Microscope, in order to help clarify these problems, hereby offers the services of its members as referees on articles on electron microscopy. The members of the committee are:

Stuart Mudd, *chairman*, department of bacteriology, University of Pennsylvania.

R. B. Barnes, American Cyanamid Company, Stamford, Connecticut.

M. Demerec, Station for Experimental Evolution, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, N. Y.

Henry Eyring, department of physical chemistry, Princeton University.

Robert F. Griggs, department of botany, George Washington University.

Caryl P. Haskins, Haskins Laboratories, 480 Lexington Avenue, New York, N. Y.

Michael Heidelberger, department of biochemistry, Columbia University.

Loyd Jones, Eastman Kodak Company, Rochester, N. Y.

C. W. Metz, department of zoology, University of Pennsylvania.

Katherine Polevitsky, Dental School, University of Pennsylvania.

Thomas M. Rivers, Rockefeller Institute for Medical Research, New York, N. Y.

Gordon H. Scott, School of Medicine, Washington University.

W. M. Stanley, Rockefeller Institute for Medical Research, Princeton, N. J.

Francis O. Schmitt, department of biophysics, Massachusetts Institute of Technology.

V. K. Zworykin, Research Laboratories, RCA Manufacturing Company, Incorporated, Camden, N. J.

T. F. Anderson, *secretary*, Research Laboratories, RCA Manufacturing Company, Incorporated, Camden, N. J.

Editors who care to avail themselves of this offer may send manuscripts to the secretary of the committee, Dr. T. F. Anderson, for reference to an appropriate referee from among the committee's membership.

THE UTAH CHAPTER OF THE SOCIETY OF SIGMA XI

THE Utah State Chapter of the Society of the Sigma Xi, the eighty-second chapter to be established in the society, was installed at the Utah State Agricultural College at Logan on March 14 by Dean Edward Ellery, member of the executive council of the society. The new chapter has fifty-five charter members who are alumni of eighteen other chapters.

At a convocation held in the morning in the college auditorium, Dr. Elmer George Peterson, president of the college, addressed the delegates and members on the subject, "The Place of Research on the Utah State Agricultural College Campus," and Dean Ellery spoke on "Sigma Xi, its Past in Peace, its Present in War."

After the formal installation exercises in the afternoon, a reception honoring the members of the new chapter was given by the faculty association in the reception room of the Commons building. A formal dinner in the evening, presided over by Dr. Sherwin Maeser, president of the new chapter, was followed by the club and chapter's fourth annual Sigma Xi lecture, "The Structure of Liquids," by Dr. John J. Kirkwood, of Cornell University.

Other new officers in the club are: Dr. R. J. Evans, *Vice-president;* Dr. J. Stewart Williams, *Secretary;* Dr. Dean F. McAlister, *Treasurer,* and Dr. Marion T. Bird, *Member of the Council.*

THE SOUTHWESTERN DIVISION

THE twenty-second annual meeting of the Southwestern Division of the American Association for the Advancement of Science will be held under the presidency of Dr. W. M. Craig, of Texas Technological College at Lubbock, at the New Mexico State College of Agriculture and Mechanic Arts at Las Cruces from April 27 to 30. Dr. H. P. Mera, of the Laboratory of Anthropology, Santa Fe, is vice-president of the division and Dr. Frank E. E. Germann, of the University of Colorado, is secretary.

The division meets in four sections—the Biological Sciences, Mathematics, the Physical Sciences and the Social Sciences. Meeting in association with the division will be: The Clearing House for Southwestern Museums, *chairman,* F. H. Douglas, Denver; the Mathematical Association of America, *chairman,* Roy MacKay, State College; the American Association of University Professors, *chairman,* G. L. Guthrie, State College; the State College Biological Society, *chairman,* P. J. Radosevich.

According to the tentative program, in addition to the section meetings on April 28 and 29 there will be on Monday, April 27, a reception for members and guests by Dean and Mrs. J. W. Brannon, and the dinner of the American Association of University Professors in the evening. The following evening will be devoted to the thirteenth John Wesley Powell Lecture. The annual banquet of the division will be given on the evening of the 29th when Dr. Craig will deliver his address as retiring president. He will speak on "The Rôle of Spectrography in National Defense."

Field trips will be arranged to meet the interests of members. Old Mesilla and the ruins of Forts Selden and Fillmore are places of historical interest. The Sunken Mesas, Lava Flows and the White Sands National Monument are features of concern to both geology and biology. The Conkling Cave, Jornada Experimental Range and the industrial and other interests of El Paso and Juarez, Mexico, may be visited within a few hours. The Carlsbad Cavern trip requires an entire day.

The Mesilla Valley offers an environment rich in anthropological remains and historical landmarks. The White Sands National Monument contains 274 square miles of dazzling white gypsum sands and a lake of unusual setting and beauty. Conklin's Cave in Bishop's Cap of the Organ Mountains was used for years by Indians and Mexicans for shelter. The village of "La Mesilla," two miles southwest of Las Cruces, was settled by Mexican colonists in 1854. Excursions are planned to these points as well as to the Jornada Experimental Range, which embraces experimental projects of the U. S. Forest Service and the New Mexico Agricultural Experiment Station.

MEETING OF THE EXECUTIVE COMMITTEE OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE executive committee met in New York on March 15. The following members were present: Drs. Livingston, *chairman;* Caldwell, Cannon, Cattell, Compton, Long, Moulton and Wrather.

Among items of business of interest to scientific men transacted by the committee are the following:

The president of the University of Michigan having withdrawn the invitation to the association to meet at Ann Arbor in June, owing to war conditions and a change in the schedule of sessions at the university, it was voted to cancel the Ann Arbor meeting.

A committee of three, consisting of Drs. Long, *chairman,* Livingston and Moulton was appointed to have charge of making arrangements for a local committee for the New York meeting at the end of the present year.

On nomination of the Section Committee of the Section on Chemistry, Dr. Hugh S. Taylor (M28, F28), Princeton University, was elected vice-president of the Section on Chemistry for 1942 in the place of Dr. Joel H. Hildebrand. Dr. Wade W. Oliver (M11, F27), Long Island College of Medicine, Brooklyn, N. Y., was elected vice-president of the Section on Medical Sciences for 1942, in the place of Dr. H. S. Gasser. On recommendation of the Executive Committee of the Section on Agriculture, Dr. W. A. Albrecht (M18, F24), University of Missouri, was elected secretary of the Section on Agriculture to fill the unexpired term of Dr. M. F. Morgan, resigned to serve as an officer in the U. S. Infantry. Dr. Sydney S. Negus was reappointed director of the Press Service for the New York meeting.

The status of the American Society of Plant Taxonomists was changed from an associated society to an affiliated society. The Washington Academy of Science was affiliated on the same basis as state academies.

The Permanent Secretary reported the approval of the Executive Committee by mail ballot of the publication of the Symposium on Relapsing Fever, organized and presented by the Section on Medical Sciences at the Dallas meeting.

On a request from the editors of "American Men of Science," the Executive Committee authorized the president (Dr. Compton) to appoint a committee, of which he will serve as chairman, to advise the editors regarding the subdivisions of science for classifying entries, the advisability of continuing the stars, and, if they are to be continued, the method of selecting them. The committee was requested to deliver its recommendations direct to the editors.

By a majority of 7 to 1, the Executive Committee authorized and directed the Office of the Permanent Secretary to publish and have mailed to all members of the association about the middle of each month an eight-page bulletin of the same general format as the journal SCIENCE.

It was voted to hold the next meeting of the Executive Committee in New York City at 10: 00 A.M. on Sunday, October 18, unless in the interim an emergency requires that a meeting be held earlier.

SCIENTIFIC NOTES AND NEWS

THE twenty-fifth anniversary as dean of Columbia College of Dr. Herbert E. Hawkes, professor of mathematics, will be celebrated by alumni, faculty and undergraduates at a dinner to be given in his honor on April 16.

J. B. DAVIDSON, head of agricultural engineering at Iowa State College, has been elected a foreign member of the Royal Swedish Academy of Agriculture.

THE Jackson-Gwilt Medal and Gift of the British Royal Astronomical Society has been awarded to Dr. R. L. Waterfield "for his general contributions to astronomy, and in particular for his photographic work on eclipses and comets and his visual observations of planets." The medal will be presented to him on April 10 at the annual general meeting.

Nature reports that the Royal Society of Arts has awarded the annual Thomas Gray Memorial Trust Prize for an invention advancing the science or practice of navigation to T. E. Metcalfe, of Windsor, for a seaman's protective suit devised by him.

THE University of London has conferred the degree of doctor of science on Dr. G. W. Scott Blair, National Institute for Research in Dairying; Dr. A. H. Cook, Imperial College of Science and Technology; C. L. Hewett, Royal Cancer Hospital (Free) and the Sir John Cass Technical Institute; Alexander King, Imperial College of Science and Technology; M. A. Phillips, Battersea Polytechnic; Dr. Eugene Rothstein, Imperial College of Science and Technology; Dr. Frank Smithson, Birkbeck College, and Professor F. R. Winton, university professor of pharmacology in University College.

DR. CHARLES F. BÖDECKER, of Columbia University, has been elected president of the International Association for Dental Research. Other officers elected are: Dr. Philip Jay, the University of Michigan, *President-elect;* Dr. H. Trendley, dean, U. S. Public Health Service, *Vice-president,* and Dr. E. H. Hatton, of Northwestern University, *Secretary.*

IT is stated in *Nature* that Colonel S. J. Thompson, governing director of Messrs. John Thompson, Ltd., Wolverhampton (water tube boilers, motor frame pressings, etc.), has been elected president of the British Institution of Mechanical Engineers, London, in succession to W. A. Stanier, chief mechanical engineer of the London Midland and Scottish Railway, whose term of office has expired.

DR. W. W. C. TOPLEY, secretary of the Agricultural Research Council, formerly professor of bacteriology and immunology at the University of London, director of the division of bacteriology and immunology of the London School of Hygiene and Tropical Medicine, has been elected to an honorary fellowship of St. John's College.

DR. JAMES H. ELDER, of the department of psychology of the University of Virginia, has become assistant professor of psychology at the Louisiana State University.

DR. A. C. HARDY, professor of zoology and oceanography at University College, Hull, has been appointed to the regius chair of natural history at the University of Aberdeen. He will become honorary director of oceanographical investigations at Hull. Dr. Hardy's work on the North Sea plankton will be continued by C. E. Lucas, chief of the research staff, who will be in charge.

DR. EDWARD BERNECKER, general medical superintendent of the hospitals of New York City, has been appointed by Mayor LaGuardia to succeed Dr. Willard C. Rappleye as commissioner of hospitals. He has been connected with the hospital department for twenty-seven years.

DR. WILLIAM M. LEPLEY, assistant professor of psychology at the Pennsylvania State College, has received a commission as Captain in the U. S. Army Air Corps. He left the college on March 1 for Kelly Field, Texas, where he expects to be associated with the classification work.

BROOKE DOLAN, II, research associate in mammalogy in the Academy of Natural Sciences of Philadelphia, has been commissioned a lieutenant in the U. S. Army Air Corps. Mr. Dolan has explored and collected for the academy in Western China and Tibet, being the collector and donor of the panda group.

DR. ELIOT ROUND CLARK, professor of anatomy in the University of Pennsylvania School of Medicine, Philadelphia, delivered on January 16 the sixth Adam M. Miller Memorial Lecture at the Long Island College of Medicine. It was entitled "The Behavior of Cells and Tissues in the Living Mammal as Observed through the Microscope."

DR. H. SPENCER JONES, Astronomer Royal of Great Britain, delivered the Symons Memorial Lecture of the Royal Meteorological Society on March 18. He spoke on "The Atmosphere of the Planets."

THE fifth series of the John Wyckoff Lectures at the New York University College of Medicine was delivered on March 24 and 25 by Dr. Richard P. Strong, professor emeritus of tropical medicine at the Harvard Medical School. His subject was "Tropical Diseases and the War." The first lecture discussed dysentery, typhus fever and plague, and the second, trypanosomiasis and onchocerciasis. These lectures were established by the Phi Delta Epsilon Fraternity in 1937 in memory of the late Dean John Wyckoff.

DR. HERBERT M. EVANS, Morris Hertzstein professor and director of the Institute of Experimental Biology of the University of California, is giving from March 24 to May 18 Sigma Xi lectures at the following colleges and universities: Louisiana State University, the University of Georgia, St. Louis University, the University of Missouri, the University of Minnesota, Michigan State College, Bucknell University, the University of Maryland, the University of Pittsburgh, Northwestern University, Kansas State College, Western Reserve University, the Ohio State University, the College of Medicine of the University of Illinois, the University of Colorado, the University of Utah, the State College of Washington, the University of Oregon and the University of Washington.

THE American Geophysical Union will hold its twenty-third annual meeting in the Hall of Government, George Washington Union, Washington, D. C., on April 3 and 4. In addition to the regular scientific sessions of the eight sections, there will be an evening lecture session on Friday, April 3, at which the fourth award of the William Bowie Medal will be made and an address by the president of the union, Dr. W. C. Lowdermilk, on "The American Geophysical Union in its Relation to the Present World Situation," will be given. This will be followed by an illustrated lecture by Dr. Bradford Washburn, director of the New

England Museum of Natural History, entitled "Recent Explorations in the Mountains and Glaciers of Alaska."

THE eighteenth meeting of the American Heart Association will be held on June 5 and 6, at Chalfonte-Haddon Hall, Atlantic City, N. J.

THE thirty-fifth annual meeting of the American Home Economics Association will be held in Boston from June 21 to 24 under the presidency of Dr. Gladys Branegan, dean of the Division of Household and Industrial Arts, Montana State College, Bozeman. The one hundredth anniversary of the birth of one of the founders of the association, Ellen H. Richards, home economist, for many years a member of the department of chemistry of the Massachusetts Institute of Technology, will be commemorated at the meeting.

THE personnel of the field party which the Armour Research Foundation is sending to Argentina at the end of the month to make an industrial survey of the country has been announced. This survey will be coordinated with a further study of projects by the entire staff of the foundation, which is affiliated with the Illinois Institute of Technology. Dr. Francis Godwin, assistant director of the foundation, will lead the field party. He will work in the field of chemical engineering; Dr. John A. Schellenberger, director of biochemistry for the Rohm and Haas Company, in the field of agricultural biochemistry; and Dr. John A. Hopkins, who has leave of absence from the Iowa State College at Ames, in the field of agricultural and industrial engineering. It is estimated that the work will require from six months to a year. Buenos Aires has been designated as headquarters, but the party will travel and work throughout the entire country. Dr. Martin H. Heeren will direct the coordination of interrelated activities in Chicago.

THE *Journal* of the American Medical Association states that a group of Latin American physicians and scientific workers met recently in Buenos Aires under the presidency of Dr. Angel H. Roffo, director of the Instituto de Medicina Experimental of Buenos Aires, to organize a Pan American Scientific Confederation for the discussion of scientific Pan American problems.

THE Federal Civil Service Commission announces that the number of technologists on the employment lists now established is not sufficient for war-time needs. Accordingly, it has recently slightly modified the requirements for these opportunities for Government employment. Salaries for the positions range from $2,000 to $5,600 a year. Applications may be filed at the Washington office until further notice. By technologist is meant a person experienced in "the necessary production, engineering and scientific research work essential for the successful operation of an industrial plant, where such plant operation is based upon a thorough and expert knowledge of a branch of an applied science," such as explosives, fuels, plastics, rubber, minerals or textiles. For the Junior positions ($2,000 a year), applicants will no longer have to take a written test, and, as before, no written test will be given for the higher positions. The maximum age limit for all the grades has been raised to 60 years.

THE employment bureau of the Society of American Bacteriologists has been transferred to Princeton and placed under the direction of Dr. Frank H. Johnson. In view of the present circumstances, leading to frequent changes in positions, special efforts have been made to enlarge the facilities and to enable the bureau to operate efficiently in aiding both employers with vacancies to fill, and applicants for positions in bacteriology and related fields, to secure prompt and satisfactory placements. The bureau will continue on its non-profit basis, which requires only a very small percentage of the salary of successful applicants for jobs, as a means of defraying operating expenses.

THERE is a demand for information as to current wildlife research being conducted throughout the United States. In order to supply this the U. S. Fish and Wildlife Service will endeavor to assemble and release annually such information in condensed form. It is therefore suggested that there be sent, before June 1, to the Fish and Wildlife Service, U. S. Department of the Interior, Washington, D. C., titles of research in progress with the year of probable completion and the name and address.

DR. CHARLES H. BROWN, librarian of Iowa State College and president of the American Library Association, announces that American libraries will be allowed to purchase $250,000 worth of scientific and technical books and magazines from Nazi-controlled Europe. The United States Government, working through the joint committee on importations, which represents seven national library associations, will allow purchase of technical material vital to the war effort. Both the American and the British Governments have agreed to the purchases by the library committee.

DATA compiled by the Council on Dental Education of the American Dental Association show that in 1933–34 there were 38.3 per cent. of students entering dental schools with less than two years of college preparation, 35.6 per cent. with two years and 26.1 per cent. with three or more years. In 1939–40, all the 39 dental schools of the United States reached a uniform requirement of two years of college work before entering the dental course. As a result the data for 1941 show no entering students with less than two years, 53 per cent. with two years and 47 per cent. with more than two years of college training. Almost half of the entering students in 1939–40 have educational qualifications beyond the minimum recommended in 1935 by the Curriculum Survey Committee of the American Association of Dental Schools (two years) and in excess of the two-year requirement of the Council on Dental Education of the American Dental Association as announced for the year 1941–42.

UNDER the Australian federal system, public education is a function of the state governments, and the six universities look to these bodies for financial support. Five years ago, however, the Commonwealth Government undertook a share of this responsibility by providing £30,000 a year to meet costs of research in the natural sciences and in economics, and of training young graduates in research technique. The funds are administered by the Council for Scientific and Industrial Research in consultation with the Vice-chancellors' Conference. The Commonwealth has now announced, according to *Nature*, its intention to raise its contribution to £40,000 a year, beginning this year, on condition that at least £9,000 a year be devoted to social science studies bearing on problems of post-war reconstruction.

ACCORDING to *Nature* a new step in the rationalization of the British fine chemical industry has been taken by the formation of the Therapeutic Research Corporation of Great Britain, Ltd., the directors of which are Lord Trent, of Boots Pure Drug Company, Ltd.; C. A. Hill, of the British Drug Houses, Ltd.; H. Jephcott, of Glaxo Laboratories, Ltd.; T. B. Maxwell, of May and Baker, Ltd.; and T. R. G. Bennett, of the Wellcome Foundation, Ltd. Although each of the directors of the new corporation is managing director of his own concern, it is not an amalgamation of these five firms. Each will retain its freedom of action in its special field, but will contribute to the common research pool; in effect, a much extended research team now becomes available for work on new drugs, and overlapping effort should be eliminated. It is also hoped to secure the interest and cooperation of research workers in academic institutions. The corporation will have at its command in the various chemical, physiological and bacteriological laboratories the choice of many different lines of approach to its problems and the call on the extensive scientific personnel and equipment of the five companies which are collaborating.

DISCUSSION

A GROUP THEORY DILEMMA OF SOPHUS LIE AND FELIX KLEIN

THE study of group theory as an autonomous subject began with the development of the theory of permutation groups which were then more commonly called substitution groups and are still sometimes denoted by this name. This development was mainly actuated by the usefulness of these groups in the study of the theory of equations as is indicated by the title of the first book on group theory, viz., "Traité des substitutions et des équations algébriques," by M. Camille Jordan (1870). Since the only non-intrinsic condition which a set of distinct permutations must satisfy in order to be a group is that it contains the product of every two and the square of every one in the set it resulted that many people at first assumed that this is the only condition which an arbitrary set of distinct elements must satisfy in order to be a group. This assumption was supported by the fact that many other sets of well-known elements which satisfy this condition intrinsically satisfy the other necessary conditions in order to be a group in the modern sense of this term.

This circumstance throws light on various early remarks relating to group theory and, in particular, on what we call here a group theory dilemma of Sophus Lie and Felix Klein, two of the most widely known names in the history of group theory as well as in the history of modern mathematics. On page 163 of volume 1 (1888) of his work entitled "Theorie der Transformationsgruppen," in three large volumes, Sophus Lie (1842–1899) said that the transformations $x' = ax$, where the absolute value of a is less than unity, constitute a group which contains neither the identity nor the inverse of any one of its elements. It is clear that the same conclusions might have been reached for similar reasons by assuming that the absolute value of the number a in the given transformations is always greater than unity since these transformations also include the product of every two of them irrespective of whether they are equal or unequal.

As definite evidence of the common inadequate notion of group at that time from the modern standpoint it may be noted that about five years later Felix Klein (1849–1925) stated on page 66 of volume 43 of the *Mathematische Annalen*, of which he was then editor, that Sophus Lie had first pointed out that for groups of infinite order it was not a consequence of the group concept that the inverse of each element of a group appears in the group. He acknowledged then that in his now well-known Erlangen Programm (1872) he tacitly made this assumption but that it should have been explicitly stated as a part of the particular groups then considered by him. It is a very interesting fact in the history of group theory that less than fifty years ago there was still such a wide-spread lack of clarity as regards the notion of group on the part of some of the most eminent mathematicians of the day. The same volume which contains the mentioned remarks by Felix Klein contains also the modern postulates with respect to an abstract group by H. Weber (1842–1913) so that darkness and light relating to this concept are here closely associated.

Neither Sophus Lie nor Felix Klein ever adopted the modern postulates for an abstract group in their writings and in volume 1 (1926), page 335, of his "Vorlesungen über die Entwicklung der Mathematik" the latter remarked that the definition of group based on such postulates is very well suited for instruction and for a clear development of the subject but not for the discovery of new ideas and new methods. He stated on the same page that both he and Sophus Lie in their early work in group theory assumed only that the product of every two of a given set of elements is in the set in order that the set is a group but that Sophus Lie found it necessary in his later work to explicitly assume also that the set includes the inverse of each of its elements as a part of the definition of the term group.

On the contrary, the group theory postulates of H. Weber, or their equivalents, were at once taken very seriously in America, largely on account of the very successful works on algebra which he published and which contain these postulates. Various attempts were made in America to obtain more useful sets of postulates. As regards group theory these efforts were conducive to caution so that the laws or commandments as regards the concept of group were not transgressed but they did not lead to any great advances within the subject itself. The dilemma of Sophus Lie and Felix Klein to which we referred above was due to the fact that in their early work they had tacitly assumed that it is unnecessary to restrict the group concept to sets of elements which always include the inverse of each element but that they later abandoned this idea.

It is questionable whether any publication contributed more than Felix Klein's Erlangen Programm towards making the subject of group theory widely known and highly appreciated. It was translated into Italian (1890), into French (1891), into English (1893), into Polish (1895), into Russian (1896) and into Hungarian (1897). Nevertheless, according to Felix Klein's own statement it contains an inadequate definition of the group concept but one which includes its most effective elements. Those who later refined this definition also made valuable contributions towards the advancement of this subject, but their work naturally received less extensive attention. Great mathematical progress was frequently made by those who failed to observe pitfalls which their successors carefully labeled and which too frequently engrossed their attention.

G. A. Miller

University of Illinois

PENTHESTES AND CALOPHYA

That black-capped chickadees are making a substantial part of their winter diet on "jumping plant-lice" along the Connecticut shore may interest zoologists; that the psyllids are found upon sumac may interest botanists; and that *Calophya flavida* in its present nymphal stage abounds on *Rhus glabra*, while *Calophya nigripennis* abounds on *Rhus copallina* may interest ecologists. The two species of sumac, growing in close admixture, carry only their proper species of psyllid, never the other one. Dr. Oman, who determined the psyllids for me, informs me that only these two species of *Calophya* are known to occur in eastern United States.

Early this winter, 1941–42, I observed chickadees feeding freely on the very abundant sumacs of this region, interested not only in the fruit clusters but also picking minute objects from the stems of these shrubs, both low down near the ground and higher up. With field-glasses permitting very close-up work I saw that they took these from areas surrounding leaf-buds also from areas close to forks in the branches primarily. With a hand lens I examined the areas the birds had just worked, and found plenty of the beautifully sculptured nymphs. Those of *C. flavida* are darker and larger and have more marginal setae than nymphs of *C. nigripennis*. The numbers of both species are diminishing, under the attacks of the chickadee, as winter progresses. The birds are also feeding on many other animal and plant foods. Had their stomach contents been examined the nymphs might never have been recognized and determined, except as pulp of animal origin.

Ralph E. Danforth

Noank, Conn.

DEGREES AT ANY TIME: BRAIN CONSERVATION

In a recent number of Science[1] the writer discussed the importance of a twelve-month college year to insure earlier completion of curricular requirements. This was prompted by the frequently expressed desire in various quarters that students have the opportunity to complete their collegiate education before reaching draft age. It was pointed out that the plan was desirable not only in war-time, but that it was a good peace-time idea. Just as the article on the twelve-month college year was a long postponed sequel to a post-World War I article,[2] so the present discussion is a sequel to an earlier article.[2] While the nation is in need of specially trained men of all capacities, it particularly wants the service of leaders and thoroughly dependable workers. Whether continuous instruction is afforded through the twelve-month college year or we follow the traditional custom of granting a long summer vacation, it seems desirable to get away from educational policies which serve only the average student. At present most institutions expect students to graduate in four years. A few get through sooner by taking summer courses. There are superior students who might cover a required curriculum in a much shorter time. There are others who can not keep the average pace, and they fail. In the earlier article to which reference was made[3] the writer likens students to automobiles, asking whether one thousand automobiles starting from New York at a given moment could all be expected to arrive at San Francisco at the same time even if they were the same model of a given make. Failure of mechanical devices to accomplish uniform service suggests that human beings, whose variations are greater than those of machines, should hardly be expected uniformly to follow a schedule. The writer feels that many superior students, who are retarded by the average pace of their fellow students, lose ambition and slow up their efforts. Also, there is no doubt that the student who can not go the average pace often gives up hope and fails.

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[1] A. Silverman, Science, 95: 192, 1942.

While the educational facilities and financial status of our colleges and universities will, in the majority of cases, not permit the plan which is proposed, it is worth looking forward to. Assuming an adequate and competent instructional staff, good library facilities and sufficient laboratory space, a student would be permitted to follow a plan or a curriculum under direction or guidance, but chiefly through self-education in the library and laboratory, to advance himself as rapidly as possible. The instructor should be available when the student requires conferences. Regularly scheduled lectures would be abandoned, and except for occasional inspirational lectures, the student would have to depend on himself and on conference guidance. No text-books would be assigned, but good texts and reading references might be suggested. Grades would be abolished, and the only criterion would be the satisfactory completion of the work done. When the courses required in a given plan or curriculum have been completed satisfactorily, instructors would certify students to the institution's registrar, and a degree could be conferred at this time. If the work has been done in a year and a half or two years, the student can either go on with graduate study or go into service—commercial, educational, governmental. The student who requires more than four years, in other words is slower than average, can go on for five or even six if necessary, and by that time satisfactorily complete his requirements instead of having failed and been deprived of a degree at the end of four years. He would deserve receiving one after all. Naturally there will be students who are incompetent. After a given time these could be asked to vacate in favor of the deserving. Each student who has satisfactorily completed the requirements for a degree is entitled to it. The majority may still require four years. Instead of "getting by" in some courses as students do at present, they complete every course satisfactorily. They are not dependent on lectures from professors and daily guidance by them, but become self-reliant. They do not walk on the crutches of the predominating educational system of our day, but possess self-confidence. The student's independent search of the literature and independent exploration of the laboratory technique develop an assurance which regularly scheduled and constant direction do not afford.

Advocates of the grading system and the appraisal of individuals on this basis might hesitate to abandon the idea of "quality in a fixed time" for "satisfactory performance in variable time periods." It is the writer's recollection that the psychologist considers satisfaction the result of successful accomplishment, and happiness dependent upon satisfaction. With this in mind the superior student or man of genius, the average student and the slow worker, all succeeding in their tasks, performing satisfactorily, could be happy in their own way instead of experiencing the anxiety which the present system must bring to many students.

The instructor, through personal contacts with individual students and the direction of their efforts, could readily ascertain whether a student's performance is satisfactory. Examinations could be given at intervals if necessary or a student might be subjected to comprehensive examination upon completion of a subject or group of courses. The student would be sent into the world of affairs as a rapid, keen thinker or worker, an average individual or as a slow but steady and dependable one. In any event he can render satisfactory service at the pace which he can go, and the world would have its genius encouraged and cultivated, its average man and its plodding but reliable servant. It would not be getting a ninety per center or an eighty per center or a seventy per center from the standpoint of quality of work done. All work would be of one hundred per cent. quality and the service would be rapid or slow, as certified when the individual graduates. Genius would not be curbed. The slow worker and average worker, learning how properly to master a task, could improve their pace gradually. We would conserve the most precious possession of man, the human brain.

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[2] *Idem, School and Society,* 12: 80, 1920.

[3] *Idem, Industrial and Engineering Chemistry,* 16: 860, 1924.

All this would cost money. We would need larger libraries, larger faculties, more laboratories. Each student would want space where he could work at any time day or night. He would want a competent advisory force to afford him conferences when required. The investment should prove worth-while. Just now, we are particularly anxious to eliminate slipshod and irresponsible performance. We need dependable individuals and good performance. After World War II is won and we are accustomed to heavy taxes, we can devote a portion of the funds collected to "brain conservation."

ALEXANDER SILVERMAN
DEPARTMENT OF CHEMISTRY,
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QUOTATIONS

THE A.A.A.S. BULLETIN[1]

EVERY member of the American Association for the Advancement of Science will receive each month a new publication, of which this is the first issue. No formal subscription for it will be required of members of the association, for its cost to them is included in their annual dues.

Broadly speaking, the purpose of the *A.A.A.S. Bulletin* is to advance science which, of course, is the purpose of all the activities of the association. But the advancement of science has a continually expanding and changing meaning. When the association was founded science was classified largely as "natural philosophy" and "natural history." Since that time science has been divided and subdivided into numerous special fields. There are now more than a thousand scientific organizations in the United States and Canada.

With the expansion of science the needs for increasing avenues of publication have led to the establishment of many special scientific journals. There has not been, however, corresponding increases in the number of journals for science in general, nor have those in existence been able to increase appreciably, if at all, the number of pages they print per year. This has been true of *Nature*, SCIENCE and *The Scientific American*. Obviously the needs of the association for journals are much greater than they were thirty or forty years ago when it held only one meeting each year and had no divisions and fewer than half as many affiliated societies, and when its membership was only a fraction of its membership to-day.

As science becomes more and more specialized, it becomes increasingly important to maintain interconnections among its various fields. That this fact is realized by specialists in the fields of the natural sciences is proved by the numerous joint symposia of sections and societies that have been held at the meetings of the association. But to specialists in these fields the social sciences, generally speaking, have been regarded until recently as being in foreign lands. It has taken the shocks of war to teach men the now obvious fact that human beings are so interdependent that no group can isolate itself from the remainder, even on the lofty peaks of pure science. The association, with its sections in the fields of both the natural and the social sciences and with its many affiliated societies from both fields, is ideally constituted to furnish opportunities for exploring the interrelations of science and society.

Several times in the past scientists have largely failed to recognize the tides in human affairs which they themselves have created. For example, when Charles Darwin removed man from his lonely and barren pedestal of a special creation, his contemporaries did not realize that he had ascribed to man all the rich qualities that flow in the varied streams of life and all its possibilities for change. Now when the applications of science have removed all the physical barriers that have hitherto separated peoples from peoples, let not the fact escape scientists that they have opened the gates to both Paradise and Purgatory. Which shall be humanity's fate now depends in large measure upon the ideals with which they inspire the world.

In order that the association may function more effectively as an integrating agency for science and society during the war, after its close, and indefinitely in the future, this publication has been established by the executive committee. It enables the office of the permanent secretary to communicate directly with *all* the members of the association. This has been impossible, except by mail, because about sixty per cent. of the members receive SCIENCE and about forty per cent. *The Scientific Monthly*. Moreover, not many of the announcements that will appear in this bulletin will be appropriate for SCIENCE and none of them for *The Scientific Monthly*, both of which will continue to occupy the distinguished positions in American science that they have long held in the past. The new publication will supplement them and provide a new medium through which the affiliated societies may make announcements of their programs and of their undertakings of general interest.

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[1] Introduction to the first issue, March, 1942, published monthly by the American Association for the Advancement of Science. The Office of Publication is at North Queen St. and McGovern Ave., Lancaster, Pa. The Editorial Office is in the Smithsonian Institution Building, Washington, D. C. The names of the editors are not given.

There is a labor and financial aspect of the establishment of this publication which merits a few comments. To send out through the mails a communication from the office of the permanent secretary to all the nearly 24,000 members of the association is so costly in labor and money that there is always pressure to refrain from doing so. Many of these desirable communications will appear substantially in this publication at much less cost. As a matter of fact, taking all the items of labor, envelopes, paper and postage into account, the cheapest mail service hitherto available to the association for communication to all members is about eight times as costly as through this *A.A.A.S Bulletin*.—THE EDITORS.

SCIENTIFIC BOOKS

OIL FIELDS

Stratigraphic Type Oil Fields. A Symposium. A. I. LEVORSEN, editor. xii + 902 pp. Illustrated. Tulsa, Okla.: American Association of Petroleum Geologists. $5.50 ($4.50, members).

PETROLEUM geologists have long construed their task as primarily a search for structure in known or prospective oil-bearing regions. They have been prone to think of oil reservoirs as the product of deformative geological processes. With the rapid accumulation during recent years of descriptive literature of numerous oil fields, it has been increasingly evident that many effectively sealed reservoirs are not the sole product of deformation. Many are primarily lenticular sand bodies, favorably interleaved in oil-bearing horizons or occurring on planes of unconformities. Some are the result of variable porosity and permeability in either limestones or sands; others are due to pinch-out up-dip of sand horizons or to the erosional truncation of sands, subsequently overlapped by an impervious cover. The East Texas field, the largest ever discovered, is thought to belong in the latter category.

Though the true character of many such reservoirs had previously been appreciated, the discovery of the East Texas field brought sharply into focus the importance of the so-called stratigraphic trap in our search for new fields. It aroused anew the suspicion that the discovery of a large reserve of oil contained in such traps awaited the evolution of a better geological technique, capable of coping with this more difficult problem. Areal and subsurface geology, geophysical exploration based on seismic or gravity determinations—all are designed chiefly to decipher structural conditions and often fall short of offering clues to the presence of stratigraphic traps.

The present volume includes descriptions of thirty-seven oil and gas fields situated in the various producing districts of the United States which illustrate the types of stratigraphic traps mentioned above. It presents factual data which should be useful in the further search for pools of this type. "New principles of future oil discovery depend to a large extent on an understanding of past experience. . . . The present volume . . . is intended as a factual background on which a further approach may be made to the causes of oil and gas accumulation and also as a basis for the reasoning necessary to future oil-field discovery" (Foreword).

The large majority of the papers deal with the vagaries of sand deposition which result in clear-cut examples of stratigraphic traps. Of especial interest are those which reconstruct paleogeographic conditions to show that the sand bodies were deposited as off-shore bars, channel filling or other familiar shoreline phenomena.

Obviously sedimentation is the controlling geological factor throughout this symposium. The volume should therefore prove most useful as a reference work in this field. Another very useful feature is the extensive annotated bibliography including 227 references to papers dealing with the same subject matter in recent geological literature.

W. E. WRATHER

DALLAS, TEXAS

ORGANIC CHEMISTRY

Identification of Pure Organic Compounds. Tables of Data on Selected Compounds of Order I. By E. H. HUNTRESS and S. P. MULLIKEN. xvii + 691 pp. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1941. $7.50.

ORDER I consists of compounds of carbon with hydrogen, or with hydrogen and oxygen. In this respect it resembles Volume I of Mulliken's four-volume work of the same title, which appeared in 1904. The general purpose, plan and function of the two, as well as the basis of primary classification, are similar. In other respects, however, they are quite different, so that this new compilation is not at all a new edition or revision of the earlier and well-known "Mulliken," but is an original contribution.

It differs from "A Manual for the Systematic Identification of Organic Compounds," by the same authors, which has appeared in mimeographed or planographed editions, and which it supplements, in that its serviceability is not dependent upon any one particular scheme of analysis. No matter what the analytical approach may be, these tables will be found useful not only to students of organic qualitative analysis, but also to all chemists concerned with the identification of unknown organic compounds. The publication appears opportunely, for many changes have occurred in such data since 1904, and a complete set of "Mulliken" has been unobtainable for many years.

Following an explanatory introduction (14 pp.), and a description of the Generic Tests of Order I (11 pp.), the succeeding chapters are devoted to Aldehydes (50 pp.); Carbohydrates (7 pp.); Acids (116 pp.); Phenols (71 pp.); Esters (75 pp.); Acid Anhydrides and Lactones (4 pp.); Ketones (43 pp.); Alcohols (83 pp.); Ethers, Hydrocarbons, etc. (120 pp.); Colored Compounds of Order I (Suborder II) (25 pp.); and 26 pp. of valuable Tables of Melting Points of Series of Derivatives of Compounds of Order I commonly used for identification purposes. An Index of Compounds according to Empirical Formula and a general Alphabetical Index of Compounds of Order I conclude the volume. In addition to these two indexes, seven of the nine genera comprising the book are immediately preceded by a separate alphabetical name index and an index of chemical types. As noted above, the "Tables of Melting Points of Series of Derivatives" constitute another index.

The introductory chapter sets forth the system used for the classification of compounds, a brief synopsis of the general procedure for identification of unknowns, the arrangement of the data on individual compounds and the nomenclature adopted. Extensive use is made of abbreviations, as is essential in a reference work of this character, to economize space and to keep down the cost.

One of the difficult problems in all discussions or tabulations of "selected" organic compounds is to decide which compounds to select from the hundreds of thousands already in the literature. In his choice of the 1,364 compounds described in the present volume, the author has restricted his list, in most cases, to compounds which are commercially available or which can be prepared readily from accessible materials.

In compiling the tables, the literature has been searched carefully and laboriously, particularly for the years 1920–1940, about 70 per cent. of the approximately 7,500 citations recorded falling within that period. Every compound described also carries its Beilstein reference.

The book is an indispensable adjunct to all laboratories where the identification of organic compounds is a matter of interest or importance. Paper, press work and binding are excellent.

Micromethods of Quantitative Organic Elementary Analysis. Second edition. By JOSEPH B. NIEDERL and VICTOR NIEDERL. xiii + 347 pp. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1942. $3.50.

THE scope of the original edition has been somewhat enlarged, while retaining the same mode of presentation. New developments, improvements and simplifications, as well as the latest important contributions, have been included. "Remarks" and "Literature" are deferred until the conclusion of the chapters, so as not to interrupt descriptions of the analytical procedures.

Organic Syntheses. Collective Volume I. Second revised edition. Edited by HENRY GILMAN. Revised by A. H. BLATT. xi + 580 pp. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1941. 6.00.

THIS follows exactly the plan of the first edition and, like it, includes all the preparations given in Volumes I to X inclusive of "Organic Syntheses." For a number of these preparations, new or improved procedures have been added. Errors have been corrected. The literature has been reviewed through *Chemical Abstracts* for 1940 (vol. 34), and to each preparation a sub-title has been supplied, giving the C. A. indexing name wherever that differs from the one used in the heading.

An Introduction to Organic Chemistry. Fourth edition. By ROGER J. WILLIAMS. xi + 628 pp. New York: D. Van Nostrand Co., Inc. June, 1941. $4.00.

SINCE the publication of the third edition of this excellent textbook in May, 1935, developments in the rapidly changing field with which it deals have necessitated this revision, to bring it up to date, while the general arrangement and method of treatment remain the same.

MARSTON T. BOGERT

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A BIBLIOGRAPHY OF PRIMATES

Bibliographia Primatologica—A Classified Bibliography of Primates Other than Man. By THEODORE C. RUCH. 241 + xxvii pages. Baltimore: Charles C Thomas. 1941. $8.50.

THIS is publication Number 4 of the historical laboratory of Yale Medical Library, and is Part I of a projected bibliography on primates. Part II will involve pathology and taxonomy. The headings used are embryology, general morphology, circulatory and lymphatic systems, respiratory system, digestive system, the endocrine glands, urogenital system, osteology, arthrology and syndesmology, teeth, muscular system and integument, nervous system and sense organs. Physiology and pharmacology: blood and circulation—respiration, digestion nutrition and metabolism, kidney and water balance, endocrine glands, animal heat, reproduction and development, muscles and skin, nervous system and sense organs, pharmacology. Psychobiology: receptive capacities, the action system, maturation of behavior, motivation of behavior, modifiability of behavior, intelligence and behavior—insight—ideation, reproductive and social behavior, miscellaneous, observational psychobiology.

There are 4,630 entries, a list of miscellaneous bibliographies and an index of authors' names of 27 pages. The book is a beautifully prepared volume of double column format, with bold-faced headings to each entry, which makes it easy of consultation. Classification is largely by subject, with items arranged by author, but in the case of literature up to the nineteenth century it is chronological. Where an entry covers two subjects it is entered under the principal one and cross indexed under the other. The effort is always to make the bibliography practical. Thus under "Habits in Nature and Captivity" the classification is taxonomic, the author believing that "Whatever the initial zeal, the discomforts of Procrustean categories soon convinced us of the folly of attempting to divide a literature where definite lines of cleavage do not exist."

Separate publications are distinguished by having the titles printed in italics. The use of capital letters is reduced to a minimum. Total pagination is given in every case. In order to make the reference as exact as possible, a system of markings is adopted which indicates the extent to which an article presents primate material. As a further means to exact determination the character of the publication is indicated—abstract, review, lecture, etc. Finally the name of the animals treated is given in abbreviation.

C. E. McClung

SPECIAL ARTICLES

OBSERVATIONS ON AN EPIDEMIC OF POLIOMYELITIS[1]

An epidemic of poliomyelitis was observed in which the transmission of the disease seemed largely limited to the late incubation and early prodromal periods, and the spread from neighborhood to neighborhood and community to community greatly influenced by human travel. The place was Walker County (population 65,000), a mountainous and mining region in north central Alabama. The epidemic began in the last week in June, reached a peak early in August, and was virtually ended by the last week in September, 1941.

Along with controlled studies of certain age groups the families of 101 of the 121 reported cases of all ages were interviewed between August 8 and November 8 in a systematic manner by the same investigator, and in 91 instances most of the families of neighbors, friends and reported contacts of the case. Unreported cases of poliomyelitis were uncovered, and many acute febrile illnesses compatible in the broadest sense with abortive poliomyelitis. No epidemic of any disease except poliomyelitis was recognized in the areas between June 15 and September 15, and the isolated cases of mumps, measles, pertussis, etc., did not exceed 10 per cent. of the frank poliomyelitis cases observed. Of the 101 individuals studied 87 had paralytic and 13 abortive poliomyelitis with myelitic or meningitic signs, and one had an acute febrile illness compatible with abortive poliomyelitis (in a like twin whose brother had paralytic poliomyelitis); five died; 85 were under six years of age.[2]

Although the residences of many of the 101 patients were among the most isolated in the eastern United States, not one patient had been isolated during the month preceding the illness. Visits were generally among relatives or church workers (the contact was frequently at the premises of a neighbor of the family visited). Of the 101 patients 81 had experienced within 34 days of onset prolonged direct contact with a prior acute febrile illness compatible with poliomyelitis (in 67 instances it was frank poliomyelitis, 38 of which had been reported and 29 unreported; 5 of the remaining 14 children had in turn been exposed 4 to 18 days prior to onset to frank poliomyelitis, and 6 others resided in or had visited an epidemic neighborhood in the same period). In 72 of the 81 instances the children played together for more than an hour, the least interval being a child's "ten minutes"; in perhaps every instance a portion of the visit was in the daytime; in many it was limited to this period and to the premises outside of the house.

In 45 instances the contact with prior poliomyelitis was multiple, frequently because of small mining camps with numerous pre-school children in daily communication with each other (most of whom developed an acute febrile illness after exposure to poliomyelitis). The virus of poliomyelitis was recovered from flies trapped near a privy used by families of four acute cases in such a camp.[3] In 37 instances of multiple contact the children lived within 300 yards of each other.

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[1] The work was supported by the National Foundation for Infantile Paralysis and the Alabama Department of Public Health.

[2] Valued assistance in the clinical study of this epidemic was received from Dr. A. M. Waldrop and staff of the Walker County Health Department; Dr. B. M. Beach, associate director of child hygiene, Alabama Department of Public Health; Dr. Earle Conwell and staff of the State Crippled Children's Bureau; Dr. A. G. Gilliam, U. S. Public Health Service; and Drs. J. D. Trask, J. R. Paul and H. A. Wenner, Yale University School of Medicine.

In 36 instances the contact with prior poliomyelitis was single, and took place in 30 (83 per cent.) before the contacted child or the victim became ill. In 18 of the 30 it occurred on the day of onset and in the remainder during the 3 days before the onset of the prodromal period in the contacted child. Among the 30 single contacts on or before the day of onset 16 of the visits were made by the child about to become ill (average distance covered was 7 miles) and 14 by the victim (average distance covered was 10 miles). The group represented for the most part the first cases in their respective neighborhoods and the most severe instances of poliomyelitis in the epidemic. Four of the 5 deaths among the 121 reported cases (and the only death among the unreported prior contacts) were in this 30; in 27 instances both contacted child and victim developed paralytic or myelitic poliomyelitis. For the 30 victims there were 20 different places of contact (and 20 different contacted children) separated by an average distance of 4.5 miles from the nearest prior poliomyelitis, reported or unreported. The prodromal period in the 30 victims began 3 to 21 days after the exposure to the contacted child (the average incubation period was 12.3 days) (Fig. 1).

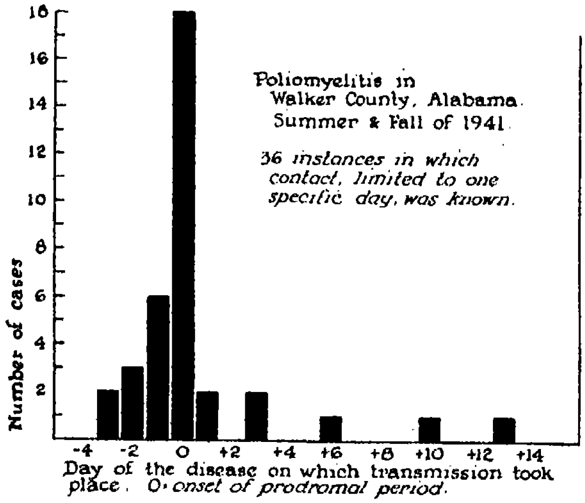

FIG. 1.

It was improbable that infected insects or other agents[3, 4, 5] traveled the average distance of seven miles and selected the same 16 victims out of a pre-school child population of over 3,000 as were visited by the 16 incipient poliomyelitis patients. If a mobile human reservoir was responsible in the 16 instances where the about-to-be-ill child did the visiting, it was equally true in the reverse, since only 14 instances were recorded of the victim visiting the incipient patient under the same circumstances. The mobile human reservoir was also a transient one, since half of the children who developed the disease visited with the patient on the day of onset (in the 36 instances where there was a single visit). It was unlikely that 50 of each clinically non-infected visitors who came from distant neighborhoods would do so on the day of onset in the incipient patient. How the virus was spread from one child to the other was not attacked in the study. The premise of insect transmission to be compatible with the present findings would require the insect to have acquired the virus from the blood, secretions or excreta of an incipient poliomyelitis patient and to have transferred it within 24 to 72 hours to a second child generally on or near the premises where the visit took place. For the premise of direct transmission of the virus from the secretions or excreta of one child to the nose, eye or mouth of the other the histories are also compatible.

Summary and Conclusions: An epidemic of poliomyelitis was observed in which human travel was a major factor in the spread of the disease from neighborhood to neighborhood and from person to person. Eighty per cent. of the poliomyelitis patients had probably visited or been visited by a prior poliomyelitis patient who was in the late incubation or early prodromal period. The effective reservoir of the virus was seemingly a patient within three days before or three days after the onset of the first prodromal symptom. Whether the effective virus was present in the blood, the secretions or the excreta of the patient at this critical period and how the transfer was accomplished was not determined.

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THE INTRAVENOUS DRIP AND OTHER INTENSIVE METHODS FOR THE TREATMENT OF EARLY SYPHILIS[1]

THE finding[2] that early syphilis may be effectively treated, and in most cases definitively cured, within 5 days by administering neoarsphenamine or Mapharsen in an intravenous drip, is of obvious importance both to the individual patient and to the current control program. This intensive procedure is, however, many times more dangerous than standard clinic practice.[3] Whether this increased risk is justified by the somewhat more rapid control of infectiousness, and by the perhaps more favorable early results achieved by the intravenous drip as compared with average clinic practice, is debatable. Nevertheless, it seems clear that the traditional schedule of weekly injections for 18 months, however effective and however safe, is wholly arbitrary. Given as three variables, (*a*) the total duration of treatment, (*b*) the number of injections and (*c*) the size of the individual dose, there are obviously an infinite number of possible combinations. Given further the fact that a 5-day and an 18-month schedule may be of comparable therapeutic efficacy, it should be possible, with the same drugs, to find effective methods of treatment which combine the speed of one and the safety of the other to an optimum degree.

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[3] J. R. Paul, J. D. Trask, M. B. Bishop, J. L. Melnick and A. E. Casey, SCIENCE, 94: 395, 1941.

[4] A. B. Sabin and R. Ward, SCIENCE, 94: 590, 1941.

[5] J. A. Toomey, W. S. Takacs and L. A. Tischer, *Proc. Soc. Exp. Biol.*, 48: 637, 1941.

[1] From the U. S. Public Health Service, Washington, D. C., and the Syphilis Division of the Department of Medicine, the Johns Hopkins Medical School, Baltimore, Md.

[2] George Baehr, William Leifer, Louis Chargin, H. T. Hyman, *et al.*, *Arch. Derm. and Syph.*, 42: 239, 1940.

Because of the very number of possible combinations of time and dose and because of the difficulties inherent in any clinical evaluation, the initial problem of orientation seemed clearly one for the laboratory rather than the clinic.

Accordingly, in the fall of 1939, we undertook to determine in syphilitic rabbits the toxicity and the therapeutic activity of twelve different treatment schedules, embracing wide variations in the frequency and duration of treatment. Mapharsen (3-amino-4-hydroxy phenylarsine oxide) was used throughout. The twelve experimental treatment schedules were as follows:

Intravenous drip (5 and 6 hours daily) for 1, 2 and 4 days.
Multiple injections each day for 1, 2 and 4 days.
Single daily injections for 1, 4 and 12 days.
Injections every other day (3 times weekly) for 4 and 8 weeks.
Weekly injections for 6 weeks.

A total of 2,000 animals has been used to date. Although the study is not yet completed, the results are sufficiently clear-cut to justify certain generalizations, presented at this time because of their implications with respect to the present-day treatment of early syphilis.

A. THERAPEUTIC EFFICACY

Within broad limits, the curative dose of Mapharsen with any one type of treatment was largely independent of the time period over which that treatment was given. Indeed, in seven schedules involving rapid intravenous injections, in which the total duration of treatment varied from 10 seconds to 6 weeks, the interval between injections from 2 hours to 1 week, and the total number of injections from 1 to 16, the minimal curative dose[4] varied only between 4 and 8 mg per kg. Although there was some suggestion that repeated doses at short intervals were more effective than either one large dose, or repeated doses at weekly intervals, the data are as yet inconclusive.

The minimal curative dose of the intravenous drip procedure, whether for one day or for four days, varied only between 7 to 12 mg per kg. It is of interest to note that Mapharsen administered by intravenous drip has been consistently less effective than Mapharsen administered by repeated injections over the same time period.

B. TOXICITY

Of primary importance is the fact that, on every treatment schedule yet tried, the total amount of arsenical which could be administered without killing the animal increased directly with the total duration of treatment. Of secondary importance is the fact that, within a fixed time period, somewhat larger amounts of arsenical could be administered by increasing the frequency of injections. Thus, on daily injections for 4 days, the maximal tolerated dose was 30 mg per kg. This was increased to 40 mg per kg by giving 4 injections daily over the same time period, and to 48 mg per kg by giving a continuous intravenous drip for six hours daily on each of four consecutive days.

This apparent advantage of the short-term intravenous drip with respect to toxicity is, however, illusory on two scores. In the first place, Mapharsen given by intravenous drip is apparently less effective than the same amount of arsenical given by simple intravenous injection. More important, since the total tolerated dose of arsenical given by simple injection can apparently be increased almost without limit merely by prolonging the duration of treatment, it is possible to administer far larger amounts of arsenical with greater safety by injections repeated daily, every other day or weekly, over a sufficient period of time.

C. MARGIN OF SAFETY ("CHEMOTHERAPEUTIC INDEX")

Since the total curative dose of Mapharsen in rabbits is, within broad limits, approximately constant, and since the total tolerated dose on any schedule of injections increases directly with the duration of treatment, it necessarily follows that *the margin of safety*

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[3] David C. Elliott, George Baehr, Loren W. Shaffer, Glenn S. Usher and S. Allan Lough, *Jour. Am. Med. Assn.*, 117: 1160, 1941.

[4] The dose which cures more than 95 per cent. of the animals, as shown by negative lymph node transfers 6 weeks and again at 6 months after treatment.

between the toxic and therapeutic dose ("chemotherapeutic index") may be increased continuously by prolonging the duration of treatment. Conversely, on any schedule of injections, the shorter the total time period over which the treatment is administered, the lower is the margin of safety afforded.

Thus, (1) on six weekly injections the total tolerated dose (60 mg per kg) was 7.5 times the minimal curative dose (8 mg per kg), as compared with a margin of 1.4 for a single injection. Moreover, the margin of safety afforded by 30 weekly injections would probably be not far from 30. (2) When the injections were given three times weekly for four weeks, the chemotherapeutic index was 12: and it is estimated that the index on a similar eight-week schedule would be about 24. (3) With four consecutive daily injections, the margin of safety was approximately 6; and it is estimated that 12 daily injections will provide a margin of approximately 10. (4) Multiple daily injections over a four-day period gave a safety factor of approximately 10; and an intravenous drip for the same period provided a margin of safety of only 4. In both cases, a shorter time period (1 or 2 days' treatment) gave an even lower chemotherapeutic index; while a longer treatment period would presumably have resulted in a correspondingly wider margin of safety.

D. Clinical Implications

In the absence of evidence to the contrary, we must assume that these same considerations apply in human beings. Indeed, such data as are available from the clinic are in accord with the dual thesis that the total curative dose of Mapharsen varies only slightly with the frequency and total duration of treatment, while the total tolerated dose varies directly with the time period over which the arsenical is administered.

The implications with respect to the treatment of human syphilis are clear. On any schedule of injections, any desired margin of safety can apparently be achieved by suitable prolongation of the treatment period. Some compromise between the vexatious 18-month schedule, as now employed, and the dangerous 5-day schedule is clearly possible. Current clinic practice calls for approximately 40 injections of 60 mg each of Mapharsen and 40 injections of bismuth over an 18-month period. If we omit from consideration the role of bismuth, which is probably of secondary importance as compared with the arsenical, and if we take due cognizance of the fact that relatively few patients in the average clinic actually complete this treatment schedule, the desideratum appears to be an intensive treatment schedule as effective as 20 to 30 weekly injections of 60 mg (1 mg per kg) Mapharsen, and providing a comparable margin of safety.

On the basis of our animal results to date, those requirements would be at least approximated by (*a*), injections of 20 mg Mapharsen (0.3 mg per kg) repeated twice daily for 4 to 8 weeks; (*b*), daily injections of 30 mg Mapharsen (0.5 mg per kg), continued for 5 to 10 weeks; or (*c*), injections of 60 mg Mapharsen (1 mg per kg) repeated three times weekly for 5 to 10 weeks. Probably dozens of schedules could be elaborated, both safe and effective, the only choice between which would be that of convenience to the patient and to the physician.

For purposes of orientation, a clinical study has been organized in twelve cooperating clinics, in which the following three schedules are being used for the treatment of early syphilis: (*a*) Injections 3 times weekly for 4 weeks. (*b*) Injections 3 times weekly for 6 weeks. (*c*) Injections 3 times weekly for 8 weeks. On the last two schedules, some of the patients are being given concomitant weekly injections of bismuth. The results to date with respect to toxicity are encouraging. Further modification may, however, prove desirable in the light of continuing clinical experience, and particularly, in the light of end-results.

HARRY EAGLE
RALPH B. HOGAN

STORAGE OF RADIOACTIVE IODINE IN A METASTASIS FROM THYROID CARCINOMA[1]

A PATIENT with metastatic thyroid carcinoma was studied from the standpoint of storage of radioactive iodine. The carcinoma was of the adenoma malignum type with widespread bone metastases showing colloid follicles, and with no evidence of recurrence of the primary growth removed thirty-five years previously from the thyroid.

A tracer dose of radioactive iodine was given by mouth, and field plots of its distribution were determined by means of a Geiger-Müller counter. The Geiger counts indicated that more of the radioactive substance had been taken up by a metastasis in the right lower femur than by the thyroid gland itself. Other metastases, which, as a therapeutic measure, had been irradiated previously with deep x-ray, failed to take up the radioactive iodine in appreciable amount. The material present in the femoral metastasis and in the thyroid gland could not be washed out of these tissues by the administration of 54 mgm of potassium iodide, which indicates that the radioactive iodine was fixed in both these tissues.

The possibility of the use of radioactive iodine as a therapeutic agent was suggested because the metastasis in the femur had fixed such a large proportion of the material. Accordingly a therapeutic dose of 10 millicuries of radioactive iodine, mainly of the 12.6 hour period, was given. The femoral metastasis took up about 30 per cent. and the thyroid gland about 6 per cent. of the total amount administered. Radioautographs of the femoral metastasis were made by placing a film on the patient's thigh and allowing the radiation from the radioactive iodine to darken the film. The position of this metastasis as shown by the Geiger counter and by the radioautographs agreed well with the area of bone destruction shown in the x-ray plates.

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[1] From the Departments of Biochemistry, Medicine, Radiology and Surgery, College of Physicians and Surgeons, Columbia University. This investigation was aided by a grant from the Josiah Macy, Jr. Foundation.

About three weeks after the therapeutic dose the metastasis had lost about 85 per cent. of the radioactive iodine, while the thyroid still contained about the same amount as that originally taken up. A tracer dose given a few days after this finding showed prompt uptake by the thyroid gland, but no appreciable uptake by the femoral metastasis. This would suggest that at least the thyroid-like function of the metastasis had been impaired.

The patient is still under observation and a complete report will be made later.

The radioactive iodine was supplied to us through the kindness of Professor E. O. Lawrence, of the University of California, and Professor R. H. Evans, of the Massachusetts Institute of Technology.

Albert S. Keston
Robert P. Ball
V. Kneeland Frantz
Walter W. Palmer

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SENSITIVE CHECK VALVE

Before carrying out electrophoresis or diffusion experiments by methods involving the study of a boundary between solvent and solution, it is necessary to bring a small volume of the colloidal solution under consideration into ionic equilibrium with the solvent, usually a dilute buffered salt solution. Although this can be accomplished by simple stationary dialysis if sufficient time is allowed, it was thought likely that the equilibrium could be attained much more rapidly if some such device as the rocking dialyzer of Kunitz and Simms[1] were used. All that was required was some means of causing the buffer solution to circulate constantly past the dialyzing membrane. As was first pointed out to the author by Dr. D. A. MacInnes, the necessary energy for such circulation can be derived from the rocking motion of the dialyzer. A well-built rocker with a reliable source of power,[2] a small reservoir attached to one end of the table of the rocker, a larger reservoir to hold the bulk of the liquid, some rubber tubing and two check valves to render flow unidirectional constitute all the essential features of the set-up used in our laboratory to obtain the desired circulation. A diagrammatic representation of the assembly is shown in Fig. 1. In order to make the apparatus work, the level of the liquid in the larger reservoir must be intermediate between the upper and lower positions of the smaller reservoir and the check valves must be sufficiently sensitive to be opened and closed by small pressure gradients. A very simple and highly sensitive check valve suitable for such purposes was designed and constructed with the aid of Mr. William Duthie, machinist in our laboratory. Because of the satisfactory service the check valve has given, it was thought desirable to publish a description of it.

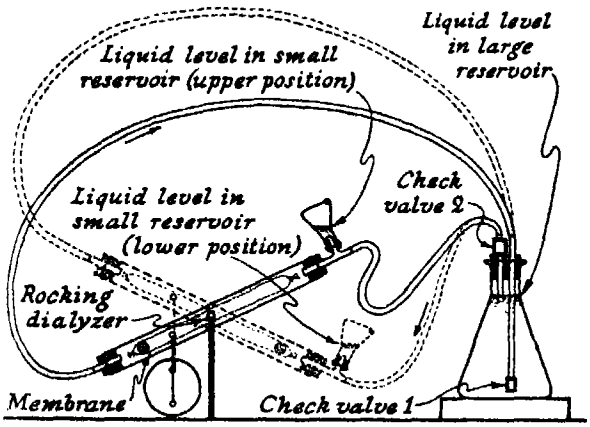
Liquid level in small reservoir (upper position)
Liquid level in large reservoir
Liquid level in small reservoir (lower position)
Check valve 2
Rocking dialyzer
Membrane
Check valve 1

Fig. 1. Diagrammatic representation of assembly for rocking circulating dialysis.

The valve consists of nothing more than a very thin sheet of rubber resting against the opening of a hole drilled into a "lucite" rod. A slight pressure tending to cause a liquid to flow out of the hole pushes the rubber film away, but an equally small pressure in the opposite direction causes it to cover the opening securely, preventing the flow of liquid in that direction. As is illustrated in Fig. 2, two modifications of the valve were constructed. The simpler of the two, No. 1, was cut from a 2-inch section of a ¾-inch "lucite" rod. After drilling a 3/16-inch hole (a) through the center of the rod from one end to within 3/16 inch of the opposite end, hereafter designated as the head, a ⅛-inch hole (b) was drilled diagonally

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[1] M. Kunitz and H. S. Simms, *Jour. Gen. Physiol.*, 11: 641, 1928.

[2] A 1/80 HP universal motor with a 1: 595 reduction gear manufactured by Bodine Electric Company of Chicago may be used for this purpose.

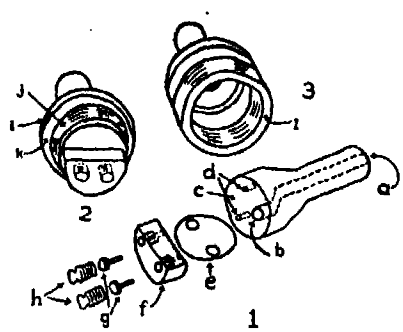

FIG. 2. The check valves. 1. Valve No. 1 shown unassembled. 2. Valve No. 2 shown assembled. 3. Cap for valve No. 2.

from near the edge of the head end so that it connected with (a). The rod was then turned down to the shape indicated in the figure, the head retaining its ¾-inch diameter and the small end being reduced to about 7/16 inch. The surface (c) was polished thoroughly. Two holes (d) were then drilled into the head as illustrated and tapped to accommodate No. 1–72 screws. A rubber diaphragm (e), about .01 inch thick, was cut to fit the surface (c), and holes were punched in it to correspond to those at (d) in the head. This diaphragm was fastened onto the head of the valve with "lucite" block (f), cut from a ¾-inch rod and held in place with two No. 1–72 brass screws (g). The holes in the block accommodating the screws were countersunk and threaded to take the "lucite" plugs (h). Valve No. 2, which is slightly more complicated than No. 1, is shown assembled. The rubber flap is shown resting against the opening of hole (b). A slight pressure from within will bend the diaphragm away, but a slight pressure in the opposite direction will cause the flap to cover the opening securely. Valve No. 1 can be used only on the end of a tube conducting liquid into some sort of reservoir. Valve 2, which is identical in principle, was cut from a 1⅛-inch "lucite" rod and was constructed in such a manner that a cap, 3, could be fitted over it, permitting it to be introduced at any point in a circulation system. A collar (i) was left at the base, and the shoulder (j) was threaded. The cap, 3, which screws onto the valve, 2, was cut from a similar rod. By polishing the surface of the collar (k) and the edge of the cap (l), it was possible to obtain a perfectly tight seal without the use of gaskets, if a little vaseline was applied to the threads before assembling.

Because of the elasticity of the rubber flap, the valve can be used in any position. Pressure differences as low as half a centimeter of water have been found to be sufficient for its operation. Constructed as it is so that only rubber and lucite are exposed, it can be used with most aqueous solutions, excepting concentrated acids and bases, and with those organic liquids which attack neither "lucite" nor rubber. Suitable materials could probably be found for making a similar valve for almost any special purpose.

The advantage of rocking circulating dialysis as here described over stationary dialysis for the equilibration of electrolyte concentrations was demonstrated by dialyzing 15 cc portions of distilled water against 2 liters of 0.2 M NaCl solution for various times using (a) rocking circulating dialysis and (b) stationary dialysis. The latter was accomplished by simply suspending the dialyzing bag near the bottom of the salt solution and allowing it to stand unagitated. Electrolyte concentrations after dialysis were estimated by measuring conductivities. As may be seen in Fig. 3, practical equilibrium is reached in about 3 hours by the rocking method but only in something more than 8 hours by the stationary method. In equilibrating viscous materials like protein solutions with electrolyte solutions, the advantages of the rocking method proved to be even more pronounced.

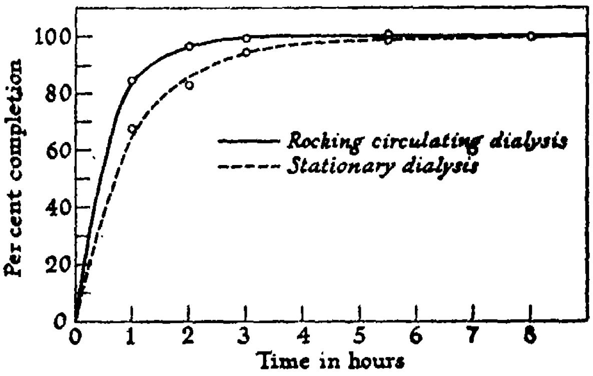

FIG. 3. Comparison of the rates of equilibration by rocking circulating dialysis and by stationary dialysis.

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BOOKS RECEIVED

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COMPTON, KARL T., ROBERT W. TRULLINGER and VANNEVAR BUSH. *Scientists Face the World of 1942.* Essays. Pp. 80. Rutgers University Press. $1.25.

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REGENERATION, DEVELOPMENT AND GENOTYPE[1]

By Professor CHARLES E. ALLEN

UNIVERSITY OF WISCONSIN

THE potentialities of a many-celled plant or animal were derived through the single cell from which the development of the organism can be traced. It follows that the genotype of such an organism is the genotype of its originating cell.

This statement is wholly true, to be sure, only if during the course of development the original genotype has not been modified. Environmental influences can induce changes in chromosome number, in chromosome constitution or in genes, and hence modifications of the genotype of the affected cells. The commonest visible type of such change in plants is a doubling of the chromosome number in some or many cells. Tetraploidy, resulting from a doubling of the typical diploid number, is of common occurrence. Ordinarily the "spontaneous" appearance of tetraploid cells must be assumed to result from an unrecognized stimulus. But in some species, including [illegible], melons and a number of Chenopodiaceae, tetraploidy and octoploidy are regularly characteristic of certain regions. Here the change seems pretty clearly not to result from external stimuli. It is in a real sense itself an expression of the plant's genotype.

The extent to which a doubling of the chromosome number constitutes a genotypic modification can for the present be tested only by the examination of deliberately induced polyploids. From these it appears that the distinguishing characters of a tetraploid offspring are essentially quantitative—changes, usually increases, in size of cells and resultant changes in size of organs and of the plant as a whole. But such quantitative modifications sometimes lead to changes in appearance which are easily interpretable as qualitative. For example, cells of *Oenothera gigas* are proportionally more greatly increased in length than in breadth as compared with those of the parent *O. Lamarckiana*. In consequence, the forms of organs, including leaves, are modified; the leaves are more crinkly than those of the parent form. Straub finds that similar quantitative modifications due to polyploidy lead in Antirrhinum, Torenia and Impatiens to conspicuous changes in shape and orientation of floral parts and in the distribution of floral pigments; and in Lupinus to a marked pubescence of leaves and stems.

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[1] Abridged version of a paper presented at the Fiftieth Anniversary Celebration of the University of Chicago, September 22, 1941.

In what follows, all effects of mutation, even though of limited extent, are to be excluded; solely to be considered is development based upon the original genotypic capital.

While it is rare that two individuals possess precisely similar genotypes, strains do exist whose members are genetically so similar that for practical purposes they may be considered together. The genotype of such a strain—*e.g.*, a clone—is naturally thought of first as expressed by the "normal" character of its members—the complex of qualities displayed under usual conditions. But these qualities are consequences of the interaction between genotype and environment; and the character of another member of the strain subjected to another set of conditions may be very different. The "normal" character of an organism, then, is but a partial expression of the range of possibilities represented by its genotype. How partial that expression may be, only extended experiment can determine. In order to know the full extent of a plant's genotype, that plant, or individuals genetically like it, must be exposed to every possible non-lethal combination of conditions. While the complete test remains only theoretically desirable, much of the information suggested by it is available from two sources.

First, with respect to the expression of particular genes or gene-combinations, genetic experiment shows that conspicuous phenotypic differences occur under diverse conditions.

Second, knowledge of genotypic possibilities is supplied by physiological experiment. In such work, it is true, care has not usually been taken to insure that the members of a species subjected to varied conditions are thoroughly comparable genetically. Hence the conclusions are to be accepted with qualifications. But, making all possible allowances, the general nature of the results demonstrates that differences in all the conspicuous characters of a plant follow upon differences in a variety of environmental conditions. Interesting light upon genotypic possibilities is thrown when certain stimuli induce the occurrence of growths classed as nodules, intumescences or galls. The remarkable form and structure of some insect galls especially manifest potentialities inherent in the plant but not expressed under usual conditions.

Evidently the genotype of any cell which can give rise to a plant includes a wide range of developmental possibilities; the plant's so-called normal character expresses only a small fraction of its inherent capacities; and, apart from mutation, any deviation from this character is in no real sense abnormal; it is at most unusual.

A distinct problem is that of the genotype of each of the tissue ("somatic") cells which constitute a plant—all derived through division from the originating cell. The Weismannian conception that qualitative nuclear divisions during ontogeny result in a progressive simplification of the nuclear content of somatic cells has of course long been untenable. Despite the regular occurrence of chromatin-diminution at certain stages in certain animals, and despite possible mitotic disturbances in any organism by external influences, an outstanding fact in both plant and animal ontogeny is the regular transmission to each cell of a chromosomal complement exactly like that which characterized the originating cell. If the genotype of any cell of a later generation is less comprehensive than that of the originating cell, the explanation is not to be found in a modified nuclear constitution.

The genotype of any of the cells of varied structure which constitute a plant is conceivably to be determined, as is that of the originating cell, by an examination of the variety of cells, tissues and organs which, under most varied conditions, can arise from the cell in question. But since any such determination depends upon the cell's ability to divide, it is necessary first to consider how wide-spread among plant cells this ability may be.

In filamentous algae and fungi, any cell, at least while young, can divide. Essentially the same is true in the gametophytes of the simpler hepatics, such as Sphaerocarpos or Riccardia. In more massive plants with differentiated tissues, the condition is less simple. Here each cell begins its life as an element of a meristem. While the meristems of a plant—distinct regions of root or stem apex, the cambium, and so on—differ somewhat one from another, all are characterized by the possibility of repeated cell division.

Some meristems, like those of stem and root apices, persist throughout the life of the organs of which they are a part. Other distinct and more or less differentiated regions sooner or later display a meristematic character. Among them are layers of cortex and phloem which may in time function as phellogen; and the pericycle of stem or root in which primordia of adventive roots commonly arise. Many other regions may become meristematic under the influence of appropriate stimuli.

While all cells originate as elements of a group which is marked by the capacity of its cells to divide, it is conceivable that in such a group cells might be formed which, destined to become differentiated, can not themselves divide. However, so many cells in so many regions do divide under ordinary or special conditions, as for instance in consequence of wounding, that it can hardly be doubted that every plant cell at the beginning of its existence and for some time thereafter is able to divide.

Obviously this power may be lost with the onset of senility. Structural difficulties, such as the development of thick walls, may hinder or inhibit division. Cells whose walls have been markedly thickened ordinarily do not divide in response to a stimulus such as that of a wound. Not a few instances are reported, however, in which such cells, becoming dedifferentiated through the loss of their secondary wall layers and through other changes, proceed to divide. They return to a meristematic condition. Hence it seems that the power of division, inherent in each cell, may long persist.

Granting this generally present capability, what is the range of the structures whose development can result from the division of a given cell? In such plants as the filamentous algae and fungi and some of the simpler hepatics, whose cells remain substantially undifferentiated, it seems to be true that from any cell a complete new plant may arise.

The possibilities are less obvious in more massive individuals, such as gametophytes of mosses and sporophytes of vascular plants. In these, it has been seen that every cell, however highly differentiated it is destined to become, begins its existence in the meristematic condition. In mosses particularly, very many of the cells of the gametophyte evidently remain throughout their active life capable of developing into new plants. The capacity is manifested by the production in many species, on the most diverse parts of the plant, of vegetative reproductive structures. Since some of the structures classed with gemmae are of the nature of abscissed leaves, branches or branch tips, this type of reproduction overlaps with the likewise wide-spread occurrence of proliferation from various organs. Such proliferation in most cases begins with the outgrowth of a cell into a protonema—a stage preliminary to the production of leafy shoots. Sometimes the first outgrowth is a rhizoid; but since rhizoids and protonemata intergrade and since either type of filament readily gives rise to the other, the distinction is not for present purposes important.

In some mosses, proliferation from parts not specifically set apart as reproductive structures occurs without apparent external stimulation; the stem bears a dense felt of rhizoids capable of developing protonemata and these in turn of producing leafy shoots. But more generally rhizoids or protonemata are put forth in response to stimuli such as those of wounds; sometimes in response to drying or to the aging or death of neighboring parts. Under these conditions, protonemata grow from leaves, from fragments of stem, branches or leaves, even from isolated sex organs or paraphyses.

As Correns has pointed out, proliferation occurs not from all the cells of a particular organ. Often the new development begins only in certain initials, which may be recognizable in advance. In the case of an organ of some thickness, as a stem, these initials are superficial. In a few species, proliferation occurs from an interior region exposed by cutting, but here also only from the thin-walled cells of certain tissues. Remembering, too, that in some mosses, notably species of Sphagnum, proliferation has not been induced by any means tried, it is clear that the broad statement sometimes made that *any* cell of a moss gametophyte is capable of this type of regeneration is not proved. On the other hand, the proliferation of particular cells often seems to be prevented by mechanical hindrances such as thickened walls. While, therefore, it is not shown that every cell can give rise to a new plant, neither is the absence of such a possibility demonstrated. Doubtless further experiment will show this potentiality possessed by at least a wider range of cells.

In pteridophytes and seed plants, functional differences become more evident between types of meristems, as shown by the nature of the tissues to which, in usual course, they give rise. Apical meristems commonly consist of fairly distinct regions, each regularly giving rise to particular primary tissues or tissue complexes. True cambium produces secondary xylem and phloem; phellogen produces cork and phelloderm.

Often, on the other hand, whole new organs with all their component tissues develop, without apparent external stimulation, from a single meristematic region. When, for instance, lateral roots develop from the pericycle, the genotype of the pericyclic cells included all the tissue potentialities of a root. If, as in the horseradish, a lateral root or a cutting therefrom gives rise to a bud and ultimately to a new plant, the genotype of the originating pericyclic cells in the primary root included all the potentialities of the race.

Buds borne on a stem which upon separation give rise to new plants are familiar. These buds, however, have arisen ordinarily from the apical meristem, and their formation as a rule involves each of the meristematic regions of the stem tip. In a different category belong adventive buds occurring commonly on stems, sometimes on roots as in the horseradish just cited, and resulting from a renewed meristematic activity of epidermal and cortical cells. New plants may develop, too, from buds formed on leaves. Hagemann lists 46 species belonging to 11 families whose leaves, still attached to the parent plant and uninjured, bear buds.

These are developments in the course of the regular life cycle. New organs may be produced also in consequence of many special causes. The causal factor is commonly a stimulus applied from without; sometimes it is the aging and death of neighboring cells or tissues, or the abscission of a leaf, bud or branch. An effective external stimulus is most frequently a wound or a development, hormonal or other, consequent upon wounding. The resultant proliferation may involve cells adjacent to, or at some distance from, the wound.

In an excised or otherwise wounded leaf, cells of all tissues beneath the wound, except, apparently, the thick-walled cells of the vascular bundles, may be stimulated to divide. In dicotyledons, a distinct phellogen often develops. Meristematic activity, continuing beneath the phellogen, produces a thickened callus. Differentiation of vascular and other tissues sometimes occurs within the callus. Adventive buds and roots may arise, as in *Crassula multicava,* from the epidermis near the wound. More frequently, buds come from superficial cell layers, roots from deeper-lying tissues. On excised scale leaves of Lilium, leaf and stem primordia arise from a secondary meristem produced by the division of subepidermal cells; root primordia from interior cells adjacent to a vascular bundle.

Wounded surfaces of stems, roots and immature fruits characteristically form calluses as do those of leaves. Stems commonly, roots much less frequently, produce new shoots from calluses. Roots may develop from internal tissues of the wounded organ; if this does not occur, they are formed sooner or later by the new shoot. On stem cuttings the new adventive buds and roots sometimes appear at a distance from the wound; or buds may appear in one region, roots in another. The particular tissues of the wounded organ whose cells are stimulated to divide vary greatly from species to species.

Similar in their causal relations to the proliferations just mentioned, but different in their development, are intumescences and galls. In certain interspecific Crepis and Nicotiana hybrids, tumorous growths occur spontaneously—perhaps in consequence of an interaction between protoplasmic substances derived from the respective parents. The more frequent forms of overgrowth result from the bites and egg-deposition of insects, from infection by bacteria or fungi or from chemical stimulation. The varied tissue types that appear in these growths, as well as the frequent production from them of adventive roots and, especially in those forming witches' brooms, of adventive shoots, indicate something of the range not only, as previously suggested, of the genotype of the cell which gave rise to the plant, but also of the genotypes of those tissue cells which produced the overgrowth.

Stimulated growth occurs also from apical meristems. Particularly suggestive are the results of the culture of excised roots or root tips of various dicotyledons. In the tomato, growth of the root and differentiation of primary tissues may continue indefinitely. Abundant branch roots are formed. But no interfascicular or cork cambium, and consequently no secondary tissues, are produced. No shoots appear. It is true that roots of the same species, while attached to the parent plant, form cambia and secondary tissues—that is, their apical meristems ultimately give rise to all the elements of a root system. But in these, as in the majority of species studied, it has not been possible to demonstrate that from a root meristem can come all the structures of a complete plant. That the limitation here suggested is not universal, however, is shown by the fact that the development of shoots from root cuttings is regular practice in the propagation of a fair number of plants.

A comparable condition holds as to the cells of leaves. Hagemann has summarized the behavior of isolated leaves of 1,204 species of gymnosperms, dicotyledons and monocotyledons. Those of 289 species regenerated both shoots and roots; those of 25 produced only shoots, which, however, in most instances themselves formed roots; leaves of 501 species produced only roots; and those of 389 formed no new structures whatever. Of 21 gymnosperms, the leaves of 6 produced roots only; the others gave only negative results.

From the available evidence, it is clear that, as has long been held, a large proportion of plant cells manifest, through the products of their division, the possession of a genotype equivalent to that of the race. But it is far from being demonstrated that all cells of all plants are in this sense totipotent. The opposite conception is suggested by the fact that, so far as experiment has shown, the cells of some tissues can give rise only to certain plant parts. Conspicuously, in the majority of angiosperms tested, leaves, roots and root meristems seem unable to regenerate complete plants. Doubtless the power of proliferation may by improved methods be shown to be more wide-spread. But for the present it must be admitted that the comprehensiveness of genotype seems to vary as between the cells of different tissues, of different organs, and even more as between cells of corresponding tissues in different species.

This conclusion, if it becomes a conclusion, contradicts the expectation derived from the general uniformity of nuclear structure throughout the life of a plant. There would seem to remain as the only possible explanation of the apparent facts the occurrence of genetically effective cytoplasmic differences between the cells of different tissues or organs. Much evidence indicates that related species may differ significantly in cytoplasmic constitution, and that this constitution favors or inhibits the expression of particular genic potentialities. The cytoplasm of a cell, then, in some measure helps to determine its genotype. The possibility is suggested that in the course of ontogeny cytoplasmic differences may appear, one consequence being that, while the ability to divide persists, the genotypic capacity of the cells of particular regions is limited. In the absence of more positive evidence, this possibility remains for the present nothing more.

THE UNIVERSITY AND THE PRESENT CRISIS[1]

By Professor ANTON J. CARLSON
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YOU have assigned me a sobering subject. The present crisis is war, all-out war. I am talking to mature colleagues, men and women trained in weighing evidence. I have worked in the college and in the university for nearly fifty years. My service in the Army in war (A.E.F.) fortunately covers a much shorter period (1917–19). But after the Armistice in November, 1918, I saw more of the backwash of war in all the war-devastated countries of Europe than perhaps any other member of the A.E.F. So I should know something of both the university and war.

To me, education and war seem to be incompatibles. Education aims at approximate truths and understanding; it tries to develop free, inquiring, fair and just minds. Education is constructive: It tries to make two blades of grass grow where only one blade grew yesterday. The student worthy of that name asks "what," "why" and "show me the evidence." The soldier obeys. Obedience to laws and the command of others are important, but not the most important lessons for citizens in civil life. Individual responsibility, understanding and performance are of more profound and abiding significance for a healthy human society. War is destructive: "The scorched earth," destructive of human life and health; destructive of the fruits of human toil; destructive of the finest, the fairest and the most frail flowers of human social evolution: the search for understanding and the attainment and application of justice. War and hate are Siamese twins. Hate and fear do not create understanding, light and happiness.

The hysteria, the fear, the false propaganda, the hopes and the necessities of an all-out war, in the very nature of things, invade the university, the college campus. Yes, even the "little red schoolhouse" and the more pretentious high school. These forces and necessities affect boards of trustees, budgets, teachers, investigators and students, just as they affect every man and woman on the street, on the farm and in the factory. If this summary is even approximately correct, how are we of the colleges and the universities to meet these terrible issues?

In the first place, we, of all people, should endeavor to keep both feet on the ground, re-examine the moorings of education for democracy and men relatively free, and not do anything obviously wrong and foolish, such as: (1) Giving the bachelor degree at the end of two years in college. For such a measure can not remedy faults and failures in our system of education. We can not do that either by giving or withholding any degree at any stage of education. Such a proposal causes plenty of confusion, at least for a time, and evades the main issue: The fault's not so much in our educational system as in us, the teachers and the students. Are all of us real teachers, do all of us really teach, by precept and by example? And do our students really study, or do they play and loiter on the way? To be sure, the bachelor degree has not the same significance of achievement in all students even in the same college or university. And I admit that an exceptional student may achieve a mastery and a training in two college years that a few other students fail to attain in four years in college. But I do not think that this applies to the mine run of the American youth. If state laws permitted, some stupid medical school faculty might give the M.D. degree to the student after a sojourn of two years in the medical school classes, as was done in our country quite generally fifty or a hundred years ago. But such a measure now would not be a step in advance of medical education.

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[1] Presented at the regional conference of the American Association of University Professors at Louisiana State University, March 6, 1942.

(2) We should not pretend that "general education" can be completed or is "completed" at the end of two years in college, on any plan; or that something significant, either for education or war, is achieved by the student or the college by giving any kind of label or degree to the student on this impossible achievement. We can, by various educational plans, subject students to a broader educational exposure during the high school, the freshman and sophomore years. Examinations will disclose the percentage of "takes" mainly in the matter of temporary memorizing. What will carry over in the line of understanding, motivation and achievement in the life of these students, no college faculty can guarantee. If I have any grasp of the meaning of "general education," that starts in infancy and continues throughout life, at least in the case of those men and women who are and who continue to be intellectually alert and intellectually omnivorous.

(3) War, and especially an all-out war, spells increased regimentation and autocratic dictation in many fields for the duration. There is not lacking signs that misplaced and myopic chairmen of college departments, deans, college and university presidents, as well as boards of trustees are being infected by this virulent virus of dictation, to the jeopardy and detriment of the essential individual freedom and responsibility, both of the members of the faculties and the students. We do not have to, we should not copy the dictators of other lands, in the field of education and fundamental research. If we do, we thereby administer a setback to college and university education in our country.

(4) The period of universal war hysteria and fear may be a time for re-examination of our educational moorings. But it is not the best period to inaugurate basic educational reconstruction. That work calls for mental calm. There is little or no evidence that human nature has undergone much change in the last hundred thousand years. Man in every land will be much the same at the end of this war. This seems to be the story of man. The Alexanders, the Caesars, the Genghis Khans, the Napoleons of the past killed and maimed people and destroyed the fruits of human toil. But they did not change man. I think the same will be true of this war. This war will make man poorer. It might be worth it, did it make him wiser. The processes of education found relatively effective yesterday will do the same work with similar youths to-morrow, if we aim at understanding and freedom, and not perpetual regimentation, violence and war.

The foregoing may be designated negative obligations on the university during the present crisis, something we should not do. There are equally important positive obligations on the university in this crisis, things that we can and must do. Among these are:

(1) A tightening of our intellectual belt, a greater attention to duty, both as teachers and students. This may mean more hours. It certainly means the old hours better spent. I have long sensed that we could dispense with the doll and the nursing bottle and advantageously add more iron to our intellectual loaf on many sectors of our educational front. This we can do now, instead of wasting our attention and time on curricula and degrees. That reminds me of Lessing's fable of the Raven and the Eagle: "The Raven saw that the Eagle sat upon her eggs for thirty days, and that from her offspring sprang the king of birds. I also, said the Raven, will sit upon my eggs thirty days, and my children shall rule the feathered kingdom. So the Raven sat upon her eggs for thirty days, but she brought forth only ravens." As applied to higher education, the obvious reply to Lessing's tale is this: we don't sit on any and all eggs. Deans and Committees on Admission select the eggs. Yes, yes, but look at some of the failures that are hatched after the four years of "sitting"—chicks that chirp, but won't scratch! If a student does not get exposed to "culture" and "general education" in every course in the college or university, that student is still in the cradle or the teacher should resign.

(2) Most universities and some colleges have laboratories, libraries and teachers needed for the training of men in the special services of our armed forces. These services and facilities should be, and I think are, at the full disposal of our government for the duration. In some cases, this may result in some inconvenience to regular undergraduate, as well as graduate students, as well as more work on the part of members of the faculty. But what of it? If special courses, if summer courses bring in additional funds to the university, it seems obvious that such funds should go to those who do the extra labor. If no extra funds materialize, we should still do this work, to the best of our ability.

(3) Most universities and many colleges have scientific men and specialists in other fields who are in position to aid our government in the solution of the numerous scientific and other problems forced on us by this war. This important war service should be, and I think is, being rendered by our universities.

(4) It would seem obvious that our colleges and universities, even during the present crisis, must continue to train the usual, if not an increased, quota of physicians, chemists and engineers each year. If this is to be done these institutions must receive the usual inflow of superior students for such training. In the case of medical students at least, this means men and women with excellent personal character, in addition to sound bodies and superior mental stuff. Such qualities are equally valuable and acceptable to our armed forces. But while the part of our armed

forces trained to kill Germans and Japanese is the spear-head of our war effort, medical and other technical services are equally essential in this organized effort. And adequate replacements of this personnel must be provided for. I think this is a special responsibility on the university in this crisis. In the case of students in or accepted by the medical schools, this is already provided for by giving such students tentative commissions in the Medical Corps of the Army or the Navy. But the able and bona-fide premedical student during his first two years in college may still be drafted. So, after a year or two, the medical schools may not have enough first-class medical students to train. That would be a catastrophe, and we must see to it that it will not come about.

(5) Many voices have been heard in our land over many years to the effect that the essential training in the high school as well as in the college can and should be done in less than the present eight years. Maybe so. It certainly can be done better, that is, more thoroughly, if we continue to use these eight years. I do not think we have as yet sufficient biological and medical information to enable us to say what amount of mental vacation is the minimum for the health of our high-school and college youth. And let us not forget that education, like the biological processes of growth, is partly a factor of time. And like growth, the educational time factor varies with the individual. In any event let us not set the limit for formal education under the stresses and hysteria of war, and let us be certain that the all-around speed-up, the longer and the more intellectually strenuous student college year does not eventuate in two degrees instead of one, the B.A. and the T.B. (tuberculosis).

(6) President Conant, of Harvard University, thinks that university students should and must decide for themselves the matter of joining our armed forces before age puts them on the call and selection for those services. With that I agree. This seems equally sound when applied to members of college and university faculties, irrespective of age. If there is a task with the armed forces that you can do better than any other man available, your duty seems clear, at least to me. But I also think that your skill and effort toward education of to-morrow's citizens are as important for our way of life and approximate justice in the world at large as gunning a German soldier or bayoneting a Japanese sailor.

(7) I have, and I do differ on many points in education with my brilliant president, Mr. Hutchins, but I see eye to eye with him on this: "What the world needs, what this country must have, is free minds—minds informed by principles derived through human experience through the ages, minds that are open no matter what waves of change beat upon them." The duty and the responsibility of aiding in the maturing of such minds rest in no small part on the university, in times of peace and in times of war. This is no mean service, if we give our all. For war creates special follies and dangers for the years that follow war. One of these is the hope that Utopia can be created by hate and violence, that war can establish "freedom from want and freedom from fear" for all men. This delusion, however useful in war, will endanger the peace, for which we are supposed to fight. We of the faculties could aid the next generation by example, by ourselves winnowing the war time propaganda chaff from the wheat of cold realism. We might also, for the better day, when the dawn of peace shall once again brighten our land, reexamine one recent trend, one segment of recent socio-economic philosophy, to wit: Our youths must be shielded from real work, from all individual social and economic responsibilities till they are 18 to 21 years of age; and, at the other end of the life span, people past 50 or 60 years of age should be cut off from work and responsibility, and supported in idleness on public pensions. Is this the best we can do for to-morrow? I think that this philosophy is unbiological, anent both ends of the life span; and instead of being kind and wise, I think that it is both cruel and stupid. This is just one of the many difficult problems before us, calling for the degree C.T.C.—clear thinking and courage. How many of us live up to that degree even during the 40-hour week?

I have presented some duties and some dont's for us, that is, the university in the present crisis. Both have been put more clearly by others. I quote from an outstanding member of our association, Professor Zechariah Chaffee, Jr., of Harvard University:

> Most of all, we need an immense amount of thinking and talking about the kind of world we want after the war. Victory is not enough unless it brings a just and enduring peace. American civilization can not stand an endless outpouring of billions for defense during a patched-up peace. The problem is enormously difficult. In 1919 we tried to put together the pieces and failed. Now there are very few pieces to put together. There will have to be a big, fresh start, and its success will depend on the continued support of the American people for a good many years after the fighting is over. Any plan framed by a few leaders, however wisely, will fail unless it responds to widespread thoughts and desires of us ordinary men and women. Whatever plan is proposed will involve drawbacks, and citizens must first have become ready to accept those drawbacks as preferable to the horrors of a third World War. That means they must be made thoroughly aware through long discussion in speech and print of the nature of the plan. The seed Wilson sowed was perhaps better than we knew in the short time it was before us. At all events, it fell on

> thin soil and was blown away. If the new seed of 1943 or 1944 or 1945 is to take firm root, the soil must first be ploughed long and deeply back and forth by the impact of ideas, until it is prepared for fertile growth. . . . Last time we *forgot* all this. We became so afraid of those who advocated a peace without victory that we put some of them in jail and scared the rest into silence and so we got a victory without peace. This time we must be wiser and not forget. Let us not in our anxiety to protect ourselves from foreign tyrants imitate some of their worst acts, and sacrifice in the process of national defense the very liberties which we are defending.

And this, from a university administrator, President Hutchins:

> The intellectual activities of the university are the symbol of everything we have to defend. The best service we can render in the defense of our country is to see to it that those activities are maintained in full force and vigor. . . . Our basic function remains the same. Another has been superimposed upon it which will make it hard, perhaps very hard, perhaps impossible to carry on our basic function. . . . That basic function, intellectual leadership, is more difficult than ever—more vital than ever. . . . To formulate, to clarify, to vitalize the ideals which should animate mankind, this . . . is the incredibly heavy burden which rests, even in total war, upon the universities. If they can not carry it, nobody else can. If it can not be carried, civilization can not be saved.

THE UNIVERSITY AND THE WAR[1]

By Dr. ARTHUR CUTTS WILLARD

PRESIDENT OF THE UNIVERSITY OF ILLINOIS

WHAT of the university in a world at war, and the place of the university in that war? As a group, the land-grant colleges—of which the University of Illinois is one—are already in the war. They have furnished a total of 75,000 reserve officers for service in the armed forces of the United States. Prior to Pearl Harbor, over 50 per cent. of our Army officers had come from the Reserve Officers Training Corps, which is still producing more than 10,000 officers a year.

The University of Illinois has always had one of the largest Reserve Officers' Training Corps units in the country, and has never questioned its obligation to both the federal and the state governments to maintain this corps on a strictly compulsory basis. At present there are over 4,200 students enrolled in the military classes, 600 of whom are in the advanced course and about 300 are in line for commissions in June as U. S. Army Officers.

But what of the other obligations of the university in the emergency? Certainly no other educational institution in the State of Illinois is faced with a greater responsibility to serve in every possible way to help win this war. It should be obvious that our most effective resources are to be found in the fields of teaching and research. In those areas we have had experience and success. We have a large and competent staff, an extensive and well-equipped plant; all of which are now at the disposal of the government for whatever war-time service is most appropriate.

"Education as usual" is, in many situations, no longer possible, and a state university should be one of the first institutions to accept this fact, and adjust its program accordingly. In my opinion, it is the first concern of the University of Illinois to help win the war. Everything else is secondary, even the much-talked-of long-time educational program so essential for making a durable peace.

Our programs of teaching and research have already been readjusted to produce more graduates in all fields in less time. Our Colleges of Medicine, Dentistry, and Pharmacy in Chicago have adopted a four-quarter system, and the colleges and schools in Urbana-Champaign have provided for an intensive summer quarter of 12 weeks in which a student can acquire full semester credit.

Nor is this the only departure from normal, as students called under the Selective Service Act may, if in good standing, receive course credit for the balance of any semester or even get their degrees if called for war service during their final semester.

Many new courses have already been established or existing courses have been specially adapted to meet the professional demands for various war services. As typical of the latter, the university is providing and teaching complete curricula in many of its colleges to permit young men from 17 to 19 years of age to enlist in the U. S. Navy under the new (V-1) program. This does not resurrect the old Students Army Training Corps. It does not put the men in college into uniform nor does it require naval drill.

There can be no question as to the importance of physical fitness for all of us in the struggle ahead, and the School of Physical Education at the university is already offering all its facilities for meeting this more serious threat to the sturdiness of our manpower.

Reference has already been made to the competence of the faculty and staff as an important resource for war-time service, both on and away from the campus. To make such service most effective and readily available, the board of trustees has made it possible for faculty and staff members to retain their positions through leaves of absence without pay when called into the military and naval service of the United States or into service essential to the prosecution of the war. The number of persons now on leave in these services exceeds 100 for military service and about 20 for defense projects, in addition to 42 who have resigned.

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[1] Excerpts from an address given in Chicago on February 26, at the Washington Award dinner of the Western Society of Engineers.

The University of Illinois has already made a special contribution to the war program of this country through the many notable research activities of its scientific staff both past and present. The Engineering Experiment Station is the oldest in the United States and probably the most active, and the Agricultural Experiment Station is one of the nation's oldest and most active. Both independently of, and in cooperation with, various departments of the Federal Government, these stations are making important researches in many fields closely related to the war activity. Of even greater significance in directly aiding the Army and Navy are the research activities of the departments of physics and chemistry. I also must mention the research and war service of the professional faculty in medicine, dentistry and pharmacy, of whom 42 are now on leave or resigned for military or naval service.

The university has two important extension organizations for rendering off-campus war-time service. The Extension Service in Agriculture and Home Economics has a staff of trained specialists who can present and interpret to the people the results of scientific research carried on by the Agricultural Experiment Station, often in cooperation with the U. S. Department of Agriculture. The Division of University Extension has been most active in making many of the resources of the university available to the entire State of Illinois. The work of this division in the field of help to industry and other activities related to the war has been in progress for many months and is very comprehensive in its scope.

(A) Most impressive is the Engineering, Science and Management Defense Training Program. Under this program, training at the college level in engineering, chemistry, physics and production management is provided in those industrial areas of the state that are in the battle of production. At this time there are in operation 28 different courses in 23 Illinois communities, for a total of 176 classes and an enrolment of 4,545 students.

(B) The Division has provided courses in conversational Spanish for the officers of the Air Corps at Chanute Field.

(C) It is having prepared by the appropriate staff members materials for courses for young men who, lacking the necessary college training for admission to the flying cadet schools of the U. S. Army, wish to prepare for the mental examination.

(D) It operates a Speakers' Bureau, an important contribution to the maintenance of civilian morale.

(E) There has been created a state-wide school and college civilian morale service to work in conjunction with the Office of Civilian Morale in Washington and the U. S. Office of Education.

(F) The Visual Aids Service of the division has acquired and is distributing motion picture films for exhibition in the classrooms on subjects that contribute to the understanding of and loyalty to fundamental American ideas and ideals.

(G) The division sponsors a research project in adult education that has been engaged in the preparation of materials and the training of teachers for the education of the foreign-born under the auspices of the U. S. Department of Justice.

(H) It conducts a number of institutes and conferences, several of which recently have been concerned with the problem of defense.

(I) Men in the armed forces, whose education is interrupted by their calls to service, are afforded opportunity to make some progress toward college degrees by the university courses that are taught by correspondence.

(J) In conjunction with the University Library, the division has projected a series of reading lists on the understanding of America, its aims, the war and the peace to follow.

The university radio station has been using all programs of a national defense nature that can be integrated with its own comprehensive 12-hour-a-day educational programs.

To maintain coordination of the many new war activities with the normal activities of the university, a Central War Emergency Committee was set up as soon as war was declared. This committee is both a clearing center and a policy recommending body of the greatest value to the administration of the university.

OBITUARY

ROBERT WILLIAM HEGNER

After an illness of several months, Robert Hegner died on March 11, 1942, at the age of sixty-two years. With increasing weakness and suffering during the last year of his life he showed the greatest courage and cheerfulness under the most trying circumstances.

He refused to give up and kept on with his lectures and the direction of the work of his department until only a short time before his death. His was an unusually active and fruitful career. Early important researches on insect embryology and a large series of books on zoology made him well known to zoologists, and extensive researches on the parasitic protozoa and the training of numerous graduate students gave him a position of leadership in the field of parasitology.

Dr. Hegner was born in Decorah, Iowa, on February 15, 1880. As a boy he was interested in the study of birds and was a pioneer in bird photography. He received his A.B. from the University of Chicago in 1903 and started graduate work in that institution. Later he changed to the University of Wisconsin, where he received the Ph.D. in 1908. For the next eight years he was a member of the zoology department of the University of Michigan. During this period he carried on researches in invertebrate embryology and published his first book, "The Germ Cell Cycle of Animals." Here, also, he published the first edition of his "College Zoology," which is still one of the leading college texts in the field of biology. The fifth edition of this book, which was completed shortly before his death, will soon appear.

In 1918, Dr. Hegner was called to the newly organized School of Hygiene and Public Health of the Johns Hopkins University to develop the work in medical zoology. Here he found his life's work in research and teaching in the field of the parasitic protozoa. From his researches he has published over 150 papers in journals in this country and abroad both on the biological and medical aspects of protozoology, including extensive contributions on malaria and amebic dysentery. He has been especially successful in training research students; forty men and women have taken the doctorate under his direction. Some of these students have already assumed positions of leadership in the field. He also found time to continue his series of text-books in general zoology and published important books on parasitology.

Dr. Hegner was a great traveler. Besides numerous trips to Europe, on which he combined scientific activities and recreation, he traveled widely in tropical America and the Orient. He directed a number of expeditions for the study of parasitic protozoa in tropical American countries, including Puerto Rico, Honduras, Costa Rica, Panama, Guatemala and Colombia. For five months in 1926 he was visiting professor at the London School of Tropical Medicine, and he spent the year of 1929 organizing a Department of Protozoology at the School of Hygiene of the University of the Philippines. During 1938, at the request of the Government of Mexico, he spent five months at the Institute of Public Health in Mexico City, conducting research and helping in the organization of the division of parasitology. His wide experience in the tropics with human protozoan diseases influenced greatly his teaching and research. In addition he was interested in the habits and customs of the peoples he visited and brought home with him extensive photographic records which were the delight of his students and friends.

Dr. Hegner's varied activities also included editorial work and membership in numerous scientific societies in zoology, parasitology and tropical medicine. For many years he was the editor of the Century Biological Series. He was for several years the contributing editor of the *Quarterly Review of Biology* and served on the editorial boards of the *Journal of Parasitology, Biological Abstracts, the Journal of Morphology* and the *American Journal of Hygiene.* He was a charter member of the American Academy of Tropical Medicine and an honorary member of British and Belgian societies. In 1935 he was president of the American Society of Zoologists and, in 1936, of the American Society of Parasitologists. In 1939 he was given the honorary degree of doctor of science by Mount Union College.

Dr. Hegner had the ability, all too rare in scientists, of popularizing his subject. In addition to numerous magazine articles for the general public he wrote in 1935 "The Parade of the Animal Kingdom," which has been one of the most popular recent books on natural history, and, in 1938, "Big Fleas Have Little Fleas," in which in a delightfully humorous way he opened up for the lay public the wonders of the parasitic protozoa.

Never satisfied with his already important accomplishments in research, Dr. Hegner was constantly pushing ahead, and during the last years before his death developed in the study of bird malaria the most important research program of his career. In his last paper, published in September, 1941, he reported the very successful treatment of bird malaria with a new drug which is now being tried on human malaria. Few men will be missed more by colleagues and friends. He was charming in all his personal relations, and his keen sense of humor and wide experience made him the most interesting and stimulating of companions.

W. W. CORT

SCHOOL OF HYGIENE AND PUBLIC HEALTH,
THE JOHNS HOPKINS UNIVERSITY

W. L. SCOVILLE

DR. W. L. SCOVILLE died in Gainesville, Florida, on March 10, 1942, at the age of seventy-seven. He was born in Bridgeport, Connecticut, where he began his pharmaceutical career in a drug store. Later he entered the Massachusetts College of Pharmacy and received the degree of Ph.G. in 1889. He was professor of pharmacy at the same institution from 1891 to 1904. From 1904 to 1907 he was an analytical chemist in Boston. He was then called to head the analytical department of Parke, Davis and Company in Detroit, in which capacity he served until his retirement in 1934.

Dr. Scoville held many important positions in national pharmaceutical bodies. He was a member of the Revision Committee of the U. S. Pharmacopoeia from 1900 to 1940. He served as vice-chairman of that committee during the period 1920–30. He was a member of the Committee of Revision of the National Formulary for the third, fourth, fifth and sixth editions. He served as chairman of the latter for the fourth and fifth revisions. His work on these two national standards for the purity of drugs was outstanding.

Dr. Scoville was awarded many honors, including the honorary doctor of science degree from the Massachusetts College of Pharmacy in 1927, the honorary master of pharmacy degree from the Philadelphia College of Pharmacy in 1929, the Ebert Prize in 1923 and the Remington Medal in 1929. He was an honorary member of the Pennsylvania Pharmaceutical Association and the Michigan Pharmaceutical Association. He was a member of the American Association for the Advancement of Science, the American Chemical Society and the American Pharmaceutical Association. He had been a member of the latter for more than fifty years. Dr. Scoville was the author of a widely used pharmaceutical text-book on the "Art of Compounding." The deceased is survived by his wife, Mrs. Lillie W. Scoville, two daughters, Mrs. Ralph D. Pearson, of Royal Oak, Mich., and Mrs. Thomas G. Spriggs, of Detroit, Mich., and four grandchildren.

P. A. Foote

University of Florida

RECENT DEATHS

Dr. Arthur Newell Talbot, emeritus professor of municipal and sanitary engineering at the University of Illinois, died on April 3, at the age of eighty-four years.

Jerome Hinds Ramskill, professor of forestry at the University of Montana, died on March 31. He was sixty years old.

Dr. Joseph Bolivar De Lee, emeritus professor of obstetrics and gynecology at the University of Chicago, died on April 2, at the age of seventy-two years.

Francis James Selby, from 1918 to 1932 secretary of the National Physical Laboratory, Great Britain, died on March 5, at the age of seventy-four years. He joined the staff of the laboratory in 1903 and was in charge of tide-prediction from 1903 to 1919 and of optics from 1903 to 1909. He was secretary of the Advisory Committee for Aeronautics from 1909 to 1919.

SCIENTIFIC EVENTS

THE INSTITUTE OF FOOD TECHNOLOGY

The third annual meeting of the Institute of Food Technology will open at the Hotel Nicollet, Minneapolis, on June 15. There will be four half-day sessions, two luncheon sessions and one round-table session.

Dr. J. C. Drummond, chief scientific adviser of the British Ministry of Food, is one of the speakers at the opening session, which is devoted to various aspects of food technology.

Monday afternoon will be given over to papers on substitute materials for food processing, on Tuesday morning the dehydration of foods will be discussed, and packaging and materials will be the subject in the afternoon.

"Industrial Sabotage," by C. W. Stein, F.B.I., special agent in charge, St. Paul, Minn., will be discussed at the Monday luncheon and "Labor Relations and the Food Technologist," by N. W. Shefferman, of Sears, Roebuck and Company, Chicago, at the Tuesday luncheon session. The subject of the round-table discussion on Wednesday morning is "Educational Requirements of Food Technologists." Industrial plant trips will be arranged for those not attending the round-table session.

The address of the president, L. V. Burton, will be delivered at the banquet on Tuesday evening, when presentation will be made of the first Nicholas Appert Medal Award, sponsored by the Chicago Section of the institute.

The Institute of Food Technologists was organized in Cambridge, Mass., in July, 1939, at the close of the Second Conference on Food Technology, held under the auspices of the Massachusetts Institute of Technology. Its officers are: *Retiring-President,* Dr. S. C. Prescott, dean of science, Massachusetts Institute of Technology; *President,* Dr. L. V. Burton, editor of *Food Industries,* New York, N. Y.; *Vice-president,* Dr. E. H. Harvey, director of research, Anheuser-Busch, Inc., St. Louis, Mo.; *Secretary-Treasurer,* Dr. G. J. Hucker, N. Y. State Agricultural Experiment Station, Geneva, N. Y.

The institute's first meeting was held in Chicago from June 16 to 19, 1940, and its second meeting was in Pittsburgh, Pa., from June 15 to 18 of last year. Its growing membership consists of more than 1,200 chemists, bacteriologists, process engineers and others similarly trained or experienced in the manufacture, preservation and handling of food.

THE ASSOCIATION OF COLLEGE GEOLOGY TEACHERS

ON Friday and Saturday, April 24 and 25, Principia College at Elsah, Ill., will be host to visiting geologists from some fourteen colleges in the Middle West at the fifth annual meeting of the Association of College Geology Teachers. Dr. Percival Robertson, professor of geology at Principia and vice-president of the association, is in charge of the program.

On Friday, after inspection of the geology department and facilities of the college, a picnic luncheon will be held along the Mississippi River. The afternoon program includes presentation of papers and informal discussion on topics relating to the contributions of geologists and geology students to the war program, more effective teaching techniques and problems common to the teachers of geology in smaller institutions. In the evening the group will be guests of the college at a banquet. On Saturday morning a short field trip to survey the Pleistocene history of the region and to collect fossils from some of the Paleozoic formations will complete the schedule.

The association was formed in the fall of 1937 by a group of its present members, who met in the field at the annual Tri-State Field Conference of Geologists from Illinois, Iowa and Wisconsin. The first meeting was held at Augustana College, Rock Island, Ill., in the spring of 1938 under the leadership of Professor Fritiof Fryxell, of Augustana College, its first president. Since then Cornell, Beloit and Lawrence Colleges have been hosts to the association.

The purposes of the association are: to foster unity and cooperation among college teachers in the earth sciences; to promote high standards of college instruction in this field; to emphasize the cultural significance of earth sciences, and to disseminate accurate geologic knowledge to the public. Papers presented at the meetings are devoted to consideration of problems and procedures in attaining these ends, rather than to presentation of new research results in geologic investigations. Any college faculty member whose duties involve the teaching of some aspect of earth science is eligible for election to membership.

A committee of the association has prepared a comprehensive list of popular and semi-popular books on geologic subjects that has proved useful as a guide to leisure reading for the layman and as collateral reading for the non-professional student. Another valuable service of the organization to its membership is the exchange of geologic specimens and teaching materials, which is a feature of the annual meetings.

Teachers of earth sciences in other colleges of the Middle West who may be interested in membership are urged to communicate with Dr. Lincoln R. Thiesmeyer, associate professor of geology at the Illinois Institute of Technology, Chicago, who is president of the association. The establishment of branches in other sections of the country is also under consideration.

Those wishing to attend the coming meeting should communicate with Professor Percival Robertson, department of geology, The Principia, Elsah, Ill., or with the secretary, David M. Delo, Knox College, Galesburg, Ill., to make arrangements for meals and lodging accommodations.

THE NINETEENTH COLLOID SYMPOSIUM

THOSE planning to attend the Boulder, Colo., Colloid Symposium, held under the auspices of the Committee of Colloid Science of the National Research Council and the Colloid Symposium Committee of the Colloid Division of the American Chemical Society, will be interested in knowing of housing facilities in and near Boulder. Early reservations are advised, since Colorado is a popular vacation center, and no one knows what to expect in the way of travel this summer. The University of Colorado Summer Session, usually enrolling over 4,000, promises to be large in addition to the fact that numerous conventions will be held in Boulder.

Rooms at the Boulderado Hotel, the Albany Hotel and the Monticello Hotel range from $1.25 single to $4.50 double. Blanchard's Lodge is situated three and a half miles up Boulder Canyon and has both rooms and cottages available at prices ranging from $1.25 single to $3.00 double.

Estes Park and Estes Park Village are thirty-one miles to the northwest of Boulder on a beautiful, paved, easy ascent mountain highway, and Denver is thirty-two miles southeast on a paved, plains highway. Good hotels are available at both places. The Boulder, Estes Park or Denver Chambers of Commerce will be pleased to send descriptive literature, lists of hotels and cottage camps to any one writing to them.

Information in regard to housing facilities can be obtained from the hotels. Other information regarding the symposium can be obtained from Dr. Frank E. E. Germann, Boulder, Colorado.

PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-sixth annual meeting of the Pacific Division of the American Association for the Advancement of Science and the one hundred and eleventh meeting of the association will be held at Salt Lake City from June 15 to 20. It will be sponsored by the Utah Academy of Sciences, Arts and Letters, the

Utah State Agricultural College, the Brigham Young University, the Weber Junior College and the University of Utah.

Officers of the division are:

President: D. R. Hoagland, University of California, Berkeley; *Vice-president:* Roy E. Clausen, University of California, Berkeley; *Secretary-Treasurer:* J. Murray Luck, Stanford University.

Members of the executive committee are:

Chairman: Roy E. Clausen, University of California, Berkeley; D. R. Hoagland, University of California, Berkeley; Ian Campbell, California Institute of Technology, Pasadena; J. Murray Luck, Stanford University; R. C. Miller, California Academy of Sciences, San Francisco; A. R. Moore, University of Oregon, Eugene; H. S. Reed, University of California, Berkeley; F. B. Sumner, Scripps Institution of Oceanography, La Jolla; Thomas G. Thompson, University of Washington, Seattle; C. L. Utterback, University of Washington, Seattle.

A general reception for members of the association and associated societies and their guests will be given on June 17 by the president of the University of Utah, Dr. LeRoy E. Cowles, and Mrs. Cowles, in the Union Building, University Campus.

There is planned on June 16 a symposium on "The Great Basin, with Emphasis on Glacial and Postglacial Times," in which Dr. Eliot Blackwelder, of Stanford University, Drs. C. L. Hubbs and R. R. Miller, of the University of Michigan, and Dr. Ernst Antevs, of Arizona, will take part. In the afternoon there will be a session devoted to reviews of current research. The presidential address of Dr. Hoagland will be delivered in the evening.

Dr. Hazel K. Stiebeling, senior food economist of the U. S. Department of Agriculture, will speak on "Nutrition in War Time" on Wednesday evening, June 17.

Excursions have been planned to afford an opportunity to become acquainted with the unique features of the region, such as Great Salt Lake, the Utah Copper Mine—the largest open-cut copper mine in the world—and with the well-preserved features of prehistoric Lake Bonneville. The moraines and other glacial features of the near-by Wasatch Mountains will also be visited. Trips are also planned to Brigham Young University at Provo and Utah State Agricultural College at Logan.

THE AMERICAN PHILOSOPHICAL SOCIETY

THE general meeting of the American Philosophical Society, Philadelphia, will be held on April 23, 24 and 25 in the hall of the society in Independence Square, Philadelphia.

Sessions for the reading of papers will be held on Thursday and Friday mornings and afternoons and on Saturday morning. These will be presided over, respectively, by Roland S. Morris, president of the society, and by Vice-presidents Dr. Frank R. Aydelotte, of the School for Graduate Studies at Princeton; Dr. Edwin G. Conklin and Professor William E. Lingenbach, of the University of Pennsylvania. On Thursday, the program will center around recent advances in American archeology.

The Franklin Medal Lecture will be given in the evening by Dr. Sylvanus Griswold Morley, associate in American archeology of the Carnegie Institution of Washington. He will describe the work of the institution in Central America and Mexico. The lecture will be followed by a number of round-tables.

The meeting of the executive session has been placed on Friday morning, when the annual report of the president, Roland S. Morris, will be presented, and the election of officers, councilors and members will take place. The executive session will be followed by a luncheon for members and invited guests.

The R. A. F. Penrose, Jr., Memorial Lecture will be given on Friday evening by Dr. James R. Angell, president emeritus of Yale University and educational councilor of the National Broadcasting Company. He will speak on "Education in a World at War." The lecture will be followed by a reception. Earlier in the evening the initial broadcast of the society will be heard over Station WRUL. On Saturday afternoon there will be an excursion and reception. The proceedings will close on Saturday evening with the annual banquet in the Hotel Bellevue-Stratford.

SCIENTIFIC NOTES AND NEWS

THE Dental Science and Dental Arts Grant-in-Aid Award of the International Association for Dental Research was presented, at the recent New York meeting, to Dr. A. H. Kniesner, of the Dental School of Western Reserve University.

DR. GEORGE R. COWGILL, associate professor of physiological chemistry at Yale University and editor of the *Journal of Nutrition,* has been awarded the Mead Johnson and Company Prize of $1,000 by the American Institute of Nutrition for researches dealing with the B-complex vitamins.

DR. EARL A. EVANS, JR., associate professor of biochemistry at the University of Chicago, has been awarded by the American Chemical Society the 1942 Eli Lilly Prize of $1,000 in biological chemistry. The award is in recognition of his work on the role of carbon dioxide in the animal body. The prize will be presented at the Memphis meeting on April 20.

At the annual meeting on March 30 and 31 of the Society of Experimental Psychologists, the 1942 award of the Howard Crosby Warren Medal was made to Professor B. F. Skinner, of the University of Minnesota, "for his experimental analysis of laws operating in one type of conditioning."

The Keith Prize of the Royal Society of Edinburgh has been awarded for 1939–41 jointly to Professor E. T. Copson, of University College, Dundee, and to Professor W. H. McCrea, of Queen's University, Belfast, in recognition of their contributions to the theory of Riemannian space and general relativity. The Neill Prize for the same period has been awarded jointly to Dr. P. C. Koller, of the Institute of Animal Genetics, University of Edinburgh, for his contributions to cytology, and to Dr. W. J. McCallien, of the department of geology, University of Glasgow, for his work on tectonic geology of the Scottish Highlands.

The degree of doctor of science has been conferred by the University of Oxford on the Reverend Theodore Evelyn Reece Phillips, the rector of Headley, Epsom; in 1927 and 1928 president of the Royal Astronomical Society.

Nature reports that Lieutenant-General A. G. L. McNaughton, recently commander of Canadian troops in Great Britain, has been elected an honorary member of the Institution of Electrical Engineers, in appreciation of the outstanding services rendered by him to promote the practical application of science to industry, especially his work on high-voltage research during his presidency of the Canadian National Research Council.

At a recent meeting of the Board of Trustees and Scientific Governors of the Chicago Academy of Sciences, Dr. Orlando Park, professor of zoology at Northwestern University, was elected a life member and honorary curator of zoology. Other elections were: *Honorary Member,* Dr. Charles H. Behre, professor of geology, Columbia University; *Life Members,* Fred Gibson, director of the Boyce-Thompson Southwestern Arboretum, Roy Komarek and Edward Komarek, and *Patron,* Henry B. Babson.

George A. Sloan, commissioner of commerce of New York City, a former president of the Cotton Textile Institute, has been named president of the Nutrition Foundation, Inc. Charles G. King, of the University of Pittsburgh, has been made scientific director in charge of research. Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, is chairman of the board of directors and Ole Salthe has been appointed executive secretary.

Officers for 1942 were elected by the Torrey Botanical Club at its meeting in January as follows: *President,* Dr. C. Stuart Gager, Brooklyn Botanic Garden; *1st Vice-president,* Dr. John A. Small, New Jersey College for Women; *2nd Vice-president,* Dr. F. Clyde Chandler, New York Botanical Garden; *Corresponding Secretary,* Dr. Harold C. Bold, Barnard College, Columbia University; *Recording Secretary,* Miss Honor M. Hollinghurst, New York City; *Treasurer,* Dr. W. Gordon Whaley, Barnard College, Columbia University; *Business Manager,* Dr. Michael Levine, Montefiore Hospital; *Bibliographer,* Mrs. Lazella Schwarten, New York Botanical Garden; *Editor of the Bulletin and Memoirs,* Dr. H. W. Rickett, New York Botanical Garden; *Editor of Torreya,* Dr. William J. Bonisteel, Fordham University.

Dr. Edward B. Holland, research professor of chemistry at the Massachusetts State College at Amherst, has retired after a service of nearly fifty years.

Professor Albert Ball, head of the department of physics at Cooper Union, New York City, will retire on June 30, after thirty-seven years of service.

Dr. Aleš Hrdlička retired, on March 31, as curator of the Division of Physical Anthropology in the U. S. National Museum, when he completed thirty-eight years and eleven months of active service with the Smithsonian Institution. As a token of the esteem of the institution he has been appointed an associate in anthropology and will continue his scientific research and serve in an advisory capacity. On April 1, Dr. T. Dale Stewart was promoted to the curatorship and administrative head of the Division of Physical Anthropology, with which he has been associated since 1924.

Dr. Myron Gordon, formerly in charge of the Fish Genetics Laboratory of the Departments of Zoology and Plant Breeding at Cornell University, recently fellow of the John Simon Guggenheim Memorial Foundation, has been appointed research associate in genetics in the New York Zoological Society and has been elected a fellow of the society. Dr. Gordon is in charge of laboratories for genetic and correlated studies in fishes which are in the Whitney Wing of the American Museum of Natural History.

Dr. Ralph E. Miller, associate professor of pathology and assistant dean of Dartmouth Medical College, Hanover, has been chosen president of the New Hampshire State Board of Health to succeed Dr. George C. Wilkins, Manchester, who has retired after serving in this capacity for many years.

Parke, Davis and Company, Detroit, and Eli Lilly and Company, Indianapolis, Indiana, have offered to sponsor, jointly, in the amount of $4,000 each, research on ergot substitutes directed by Professor Frederick F. Blicke, of the University of Michigan.

THE South Dakota Academy of Science will meet in Vermillion at the University of South Dakota on May 1 and 2. Dr. Walter F. Loehwing, head of the department of botany at the State University of Iowa, will speak on "Recent Advances in Botanical Research."

THE annual Edward Gamaliel Janeway Lectures at Mount Sinai Hospital were delivered by Dr. Michael Heidelberger, associate professor of biochemistry at the College of Physicians and Surgeons, Columbia University, on April 7 and 10. His subject was "Newer Concepts of Infection and Immunity and Chemistry's Part in Their Development."

DR. THOMAS FRANCIS, JR., professor of epidemiology at the School of Public Health, University of Michigan, addressed the University of Cincinnati Section of Sigma Xi on March 25. He spoke on "Immunity to Epidemic Influenza."

DR. JEAN PERRIN, French physicist and Nobel laureate, is delivering a series of lectures on the atom at Wilson College, where he is a guest scholar this semester. Dr. Perrin is also dean of sciences and medicine in the Franco-Belgian Institute for Advanced Studies in New York City.

THE thirteenth scientific meeting of the Association for Research in Ophthalmology will be held in Atlantic City on June 9, at the Marlborough-Blenheim Hotel.

THE Long Island College of Medicine is introducing a series of visiting professorships, financed from the Commonwealth Fund, of $4,500 a year for three years. It is planned to invite scholars from other institutions for short periods to make specific contributions to the curriculum. Dr. Thomas Addis, of Stanford University School of Medicine, is the first lecturer under the new plan. He will remain for six weeks as the guest of Dr. Tasker Howard, professor of medicine. Dr. Wilson G. Smillie and members of his staff at Cornell University Medical College have accepted the invitation of Dr. Wade W. Oliver, professor of bacteriology, to give in the spring a course in parasitology and tropical medicine to the second- and third-year classes.

A CHAPTER of the Society of Sigma Xi has been installed at Louisiana State University. Addresses were made at the installation ceremony by Dr. Edward Ellery, of Union College, and Dr. Herbert McLean Evans, of the University of California.

REPRINTS of the articles that appeared in *Chemical and Engineering News* for January 10 and 25 on "Industrial Research in the United States and Foreign Countries in 1941" by William A. Hamor, Mellon Institute, Pittsburgh, are being distributed on request free of charge to those who are interested.

THE Institute of Medicine of Chicago offers its annual Joseph A. Capps Prize for medical research of $400 for 1942 for the most meritorious investigation in medicine or in the specialties of medicine. The investigation may also be in the fundamental sciences provided the work has a definite bearing on some medical problem. Competition is open to graduates of Chicago medical schools who completed their internship or one year of laboratory work in 1940 or thereafter. Manuscripts must be submitted to the Secretary of the Institute of Medicine of Chicago, 86 East Randolph Street, not later than December 31, 1942.

THE *Journal* of the American Medical Association states that as a result of the decision of the fourth Brazilian Congress of Ophthalmology, held in Rio de Janeiro in July, 1941, the Brazilian Council of Ophthalmology has been founded. The chief functions of the council are: (1) to promote the development and progress of the specialty in Brazil and to establish standards of fitness to practice ophthalmology, (2) to act as preceptors for prospective students of ophthalmology and (3) to arrange and conduct examinations to test the qualifications of those who practice ophthalmology and desire a certificate to prove that they meet the standards established by the council. The council will be formed by the professors of ophthalmology from the medical schools of Rio de Janeiro, São Paulo, Bahia, Porto Alegre, Recife and Bello Horizonte and the presidents of the Brazilian Association of Ophthalmology and of four other state ophthalmologic associations. There will be a central executive board and a regional board in each one of the twenty states of Brazil.

STATISTICS will be emphasized in the first summer session, June 8 to July 15, of the Iowa State College at Ames. Courses in the mathematical theory of statistics and its applications will be offered by the regular staff, supported by five visiting lecturers—Professors Gertrude M. Cox, F. R. Immer, E. J. Kraus, P. R. White and Dr. W. J. Youden. The design of experiments and of other sampling investigations important in the present emergency will receive special consideration. The departments of agronomy, animal husbandry, botany, economics and sociology, foods and nutrition, genetics, horticulture and mathematics are cooperating, the effort being sponsored by the Statistical Laboratory.

GIFTS to the University of Michigan from the W. K. Kellogg Foundation include $2,228 to publish "Community Workshop for Teachers in the Michigan Community Health Project," as one of the Monographs on Education; $113,000 for the purchase of equipment for undergraduate students in the School of Dentistry and for alterations and additional equipment in the undergraduate laboratories and clinics, and $35,000 for a program of rehabilitation of the facilities of the Department of Pediatrics and Communicable Diseases.

Nature writes: "The January issue of the *Anglo-Swedish Review* announces that the Bergianska Trädgärden or Bergianum, the botanical garden of Stockholm, is to mark its hundred and fiftieth anniversary this year. It was founded in 1791 by Peter Jonas Berg, a doctor of medicine and a botanist, who bequeathed it to the Swedish Academy of Science. It consists of a purely scientific botanical section and a practical section, which in peace-time carries on a large exchange of seeds with most of the botanical gardens abroad. Among the latter is the botanical garden of Tokyo, which had to place considerable orders to complete its collections, part of which were destroyed in the earthquake ten years ago. The Bergianum is also in close touch with the United States, and some plants from the salt steppes of Russian Turkestan recently came from Russian botanical gardens. Most of the seeds received are of purely scientific interest, but sometimes seeds and plants of commercial value are also received. The results of experiments on the effects of the vigorous cold of the last two years on different plants will shortly be published in *Acta Horti Bergiani,* which contains the results of research work in systematics, cytology and embryology. The celebrated collection known as 'Iconotheca Botanica Bergiana' contains 10,000 photographs by most of the botanists in the world."

DISCUSSION

THE EARLIEST ACCOUNT OF THE ASSOCIATION OF HUMAN ARTIFACTS WITH FOSSIL MAMMALS IN NORTH AMERICA

ON Saturday, 12 January, 1839, the following communication appeared in *The Presbyterian,* a weekly newspaper published at Philadelphia:

> THE MAMMOTH
>
> It is with greatest pleasure, the writer of this article can state, from personal knowledge, that one of the largest of these animals, has actually been stoned and buried by Indians, as appears from the implements found among the ashes, cinders and half burned wood and bones of the animal. The circumstances are as follows:
>
> A farmer in Gasconade county wished to improve his spring, and in doing so, discovered, about five feet beneath the surface, a part of the back and hip bone. Of this I was informed by Mr. Wash, and not doubting but the whole, or nearly the whole skeleton might be found, I went there and found as had been stated, also a knife made of stone. I immediately commenced opening a much larger space; the first layer of earth was a vegetable mould, then a blue clay, then sand and blue clay. I found a large quantity of pieces of rocks, weighing from two to twenty-five pounds each, evidently thrown there with the intention of hitting some object. It is necessary to remark, that not the least sign of rocks or gravel is to be found nearer than from four to five hundred yards; and that these pieces were broken from larger rocks, and consequently carried here for some express purpose.—After passing through these rocks, I came to a layer of vegetable mould; on the surface of this was found the first blue bone, with this a spear and axe, the spear corresponds precisely with our common Indian spear, the axe is different from any one I have seen. Also on this earth was ashes nearly from six inches to one foot in depth, intermixed with burned wood, and burned bones, broken spears, axes, knives, &c. The fire appeared to have been the largest on the head and neck of the animal, as the ashes and the coal were much deeper here than in the rest of the body; the skull was quite perfect, but so much burned, that it crumbled to dust on the least touch; two feet from this, was found two teeth broken off from the jaw but mashed entirely to pieces. By putting them together, they showed the animal to have been much larger than any heretofore discovered. It appeared by the situation of the skeleton, that the animal had been sunk with its hind feet in the mud and water, and unable to extricate itself, had fallen on its right side, and in that situation was found and killed as above described, consequently the hind and fore foot on the right side, were sunk deeper in the mud, and thereby saved from the effects of the fire; therefore I was able to preserve the whole of the hind foot to the very last joint, and the fore foot all but some few small bones that were too much decayed to be worth saving. Also between the rocks that had sunk through the ashes, was found large pieces of skin, that appeared like fresh tanned sole leather, strongly impregnated with the ley from the ashes, and a great many of the sinews and arteries were plain to be seen on the earth and rocks, but in such a state as not to be moved, excepting in small pieces, the size of a hand, which are now preserved in spirits.
>
> Should any doubts arise in the mind of the reader, of the correctness of the above statement, he can be referred to more than twenty witnesses, who were present at the time of the digging.[1]

The author of this communication was Albert C. Koch, fossil-hunter and proprietor of a museum at St. Louis, Missouri. Koch made a living by exhibiting his fossil collections all over America, in the British Isles and in Germany, and by selling to museums. He was greatly respected by his contemporaries, and tribute to his scientific honesty was paid by no less a person than Richard Owen, the great English comparative anatomist. But American scientists of a later generation looked askance upon this "traveling salesman and publicity boy"; he was regarded as definitely not "quite. . . ." Furthermore, there was no precedent for such a discovery as he claimed to have made. For these reasons a great deal of ingenuity was spent in discrediting both Koch and his claims. No one made the slightest attempt to check Koch's claims on the spot, and no one exhibited the least interest in examining the artifacts which Koch claimed to have discovered, in spite of the fact that he took considerable pains to make their whereabouts quite clear.

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[1] *The Presbyterian.* Philadelphia and New York, Saturday, 12 January, 1839, 9: 2, whole no. 418, p. 8.

The skeleton to which Koch refers was purchased in 1843 by the British Museum, where it now is. Up to the time of its discovery, and for long afterwards, it represented the most perfect specimen of *Mastodon giganteum* in existence. The human artifacts and other remains found with this creature, and those found a year later with another *Mastodon*, were sold to the Royal Museum of the University of Berlin.[2]

For reasons which reflect little credit upon those guilty of such name-calling Koch has in the present century been referred to as a "Munchausen" with too vivid an imagination. The fact is that any one reading Koch's own accounts in the light of the discoveries made within the last fifteen years in North and South America would be compelled to credit him either with supernatural powers or else with the intelligence to observe clearly and to describe carefully what he had found, for claims such as Koch's have since been made and independently confirmed down to the last detail in many parts of North and South America.

A complete account of Koch's important discoveries together with an analysis of them and his critics' criticism is being prepared for publication elsewhere. It is here only necessary to remark that the evidence presented by Koch was, and is, unequivocally clear, and indisputably renders his the earliest discovery and account of the association of human artifacts with fossil mammals in North America.

I am extremely grateful to Mr. C. Bernard Peterson, the able assistant librarian of the Philadelphia Academy of Natural Sciences, for bringing Koch's pamphlet of 1841 to my attention, an act which led to those further inquiries which, when published, will completely serve to vindicate Koch and his discoveries.

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RETURN OF A MARKED SALMON FROM A DISTANT PLACE

SEARCH and inquiry[1] failed to reveal a single clear case of return of a salmon from a distant place in the sea to its home stream. Nor did the subsequent symposium on salmon migration[2] elicit such a case, but rather it emphasized the importance of marking salmon before they had left their rivers to determine where those from a certain river actually are to be found in the sea and of tagging them as found to test their return to the home stream.

Of 31,359 Atlantic salmon smolts, marked during descent of the Northeast Margaree River, Cape Breton, as smolts in 1938 by removal of the adipose fin, recaptures were reported of 581 of these in 1940 and 410 in 1941 in the waters of western Cape Breton and the neighboring mainland of Nova Scotia as far as Pictou and Guysborough. Dr. A. A. Blair, of the Newfoundland Fisheries Research Institute, has very kindly furnished details for a single one taken at Bonavista on the east coast of Newfoundland and tagged and released by him on June 17, 1940. It was taken again, on September 21, 1940, by an angler, Mr. M. R. Jackson, in the Northeast Margaree River above where it had been marked. The distance for this return through the sea is at least 550 miles, and Bonavista is alongside the Labrador current, very remote from any influence of the Margaree River that might aid the return. This was the only one of the marked salmon reported from Newfoundland waters and apart from the question of precise migration, the chances of its capture in either place were assuredly very small.

In agreement with the rarity of tagged, Margaree salmon kelts on the east coast of Newfoundland,[3] this was the only marked fish among the 65 salmon larger than grilse and a larger number of grilse tagged at Bonavista (grilse are very rare among the Margaree salmon). This indicates that it was far away from the bulk of the marked fish, which were evidently congregated (458 taken in 1940 and 266 in 1941) along the 16-mile stretch of coast, largely north of the river mouth, where is the definite zone of influence of the Margaree River.

We can not know what course this fish took in its return, and other recaptures of those tagged at Bonavista do not help us since they were on the Labrador coast to the north as well as on both Newfoundland and Canadian coasts. That return may not be direct is evidenced by double recaptures of salmon tagged on the Norwegian coast,[4] which revealed a to and fro movement of even more than fifty miles. That return was probably not direct is shown by marked Margaree fish tagged on the Margaree coast in 1941 moving only (so far as definitely revealed) away from the river, even past other salmon rivers.

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[2] Albert Koch, "Description of the Missourium, or Missouri Leviathan; Together with its supposed habits, Indian Traditions concerning the location from whence it was exhumed; Also, Comparisons of the Whale, Crocodile, And Missourium, with the Leviathan, As described in the 41st chapter of the Book of Job." 1st Edition. St. Louis: Printed by Chas. Keemle, No. 22 Olive Street. 1841. (On the yellow cover of the pamphlet the date is printed "1840.") 8vo. 2nd Edition, Enlarged. Louisville, Ky. Prentice and Weissinger, Printers, 1841. 8vo. A. C. Koch, "Mastodon Remains, in the State of Missouri, together with Evidences of the Existence of Man contemporaneously with the Mastodon." *The Transactions of the Academy of Science of St. Louis.* St. Louis, 1857, vol. 1, pp. 61–64.

[1] A. G. Huntsman, SCIENCE, 85: 313–314, 1937.

[2] Public. No. 8, Amer. Assoc. Adv. Sc.: 1–106, 1939.

[3] A. G. Huntsman, *Jour. Fisher. Res. Bd. Can.*, 4: 96–135, 1938.

Such maturing salmon have been proved to move in one direction or another as much as 28.9, 35 and 62 miles per day.[5, 6, 7] Also it seems quite definite that they tend to remain in river water,[8] and their usual tendency to ascend the home stream when a choice is presented where two estuaries fork[9] may be due to their remaining in water from the home river—rather than in that from another river.

Is this case to be taken as representing a regular precise migration of Margaree salmon to the waters east of Newfoundland and back, or did this fish wander from the others and get back a distance of 550 miles in 96 days or less by more or less random movements and by tending to remain in river water, particularly from its home river? The facts for our salmon do not harmonize with the conception of a somewhat precise mass migration to a distant feeding ground, but they give no indication as to the degree of success in return from distant places. Much more work needs to be done.

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HATCHING OF THE BLUE CRAB, CALLINECTES SAPIDUS RATHBUN[1]

Since 1940 efforts have been made to devise a method for hatching eggs of the blue crab, *Callinectes sapidus* Rathbun, in the laboratory and in nature on a large scale. The egg mass or "sponge" contains upward to two million eggs. When once it was found possible to hatch large quantities of eggs to the first true zoea stage, attempts were made to induce further normal development of these zoeae.

In 1940, positive hatching results were obtained by removing masses of eggs, about one cubic inch in size, from a single "sponge" and placing them in large well-aerated tubs, in some of which the water circulated slowly while in others the egg masses were moved through the water so as to simulate natural conditions. Considerable numbers of eggs were hatched under these conditions, but numerical counts were not made to indicate the percentage that hatched into either the prezoeal stage or the first true zoeal stage.

In 1941, it was found that "sponges" may be removed from freshly gathered crabs in the field or from those that have been brought to a commercial crab house, transferred to the laboratory, cut up into small pieces and hatched out in shallow pans. Under favorable conditions, the percentage of eggs that hatched into the first true zoeal stage was 90. When hatching occurred under unfavorable conditions, the larvae usually emerged bearing one or both of the following: inner egg shell membrane and the prezoeal skin.

Under laboratory conditions, it was possible to rear the larvae from the first true zoeal stage to the second stage. This provides a positive basis for identifying these zoea of the blue crab in plankton. Reasonably certain recognition of further zoeal stages of this species should be possible by using the characters recently listed by Aikawa.[2]

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THE PERIOD OF GONADAL ACTIVITY IN THE MARYLAND MUSKRAT

As part of a program to investigate reproduction in the muskrat, an extensive histological study has been made of the ovaries and testes of the adult Maryland muskrat. The following preliminary statement is based on the results of examination of sample 8 µ sections of one testis and epididymis from each of 222 male reproductive tracts and of complete serial 10 µ sections of one or both ovaries from 340 female reproductive tracts. The animals were trapped at frequent intervals throughout several years on the Blackwater Migratory Bird Refuge near Cambridge, Maryland. The principal purpose of the study was to determine the periods of gonadal activity and inactivity in the Maryland muskrat as indicated by the presence or absence of spermatogenesis and ovulation in the specimens studied. This report constitutes a summary of the findings; the details will be published elsewhere.

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[4] Knut Dahl, *Salm. Trout Mag.*, 88: 229–234, 1937.

[5] D. L. Belding and G. Préfontaine, *Contr. Inst. Zool. Univ. Montr.*, 3: 1–58, 1938.

[6] W. J. M. Menzies, *Fisher. Scott. Salm. Fish.*, 1937, No. 1: 1–17, 1937.

[7] K. Dahl and S. Sømme, *Norsk. Vid.-Ak. Oslo, Mat.-Nat. Kl.* 1935, No. 12: 1–27, 1936.

[8] A. G. Huntsman, *Bull. Biol. Bd. Can.*, 51: 1–20, 1936.

[9] H. C. White, *Jour. Biol. Bd. Can.*, 2: 391–400, 1936.

[1] Contribution Number 8 of the Virginia Fisheries Laboratory and the Department of Biology, College of William and Mary.

[2] H. Aikawa, *Rec. oceanogr. Works Japan*, 9: 87, 1937.

Spermatogenesis was found to begin rather abruptly in the middle of December. In the great majority of animals, large quantities of sperm were found in both testes and epididymides from the beginning of January until the beginning of October, when spermatogenetic activity began to decrease. No indication of spermatogenesis and very little sperm storage were observed in the reproductive tracts of the 24 males trapped between October 22 and November 26. Similar inactivity was noted in all but three of the 21 males trapped between November 27 and December 11; spermatogenetic activity was limited in the three exceptional males.

Study of the serially sectioned ovaries involved a search for ripe follicles and particularly for corpora lutea as indicators of imminent or actual ovulation, respectively. Although present in one or both ovaries of four of the 54 females trapped between January 21 and February 15, corpora lutea did not make their appearance in a significant number of cases until the latter part of February. Corpora were present thereafter in significant numbers of specimens until the last part of October. There was no evidence of ovulation in the 69 female tracts from animals taken between October 29 and January 14, with the exception of one pregnant animal trapped on December 11.

Cognizance must be taken of the probability that there are minor variations in the extent of the periods of ovarian and testicular activity from year to year. However, the evidence indicates that in the Maryland muskrat spermatogenesis begins in the middle of December and ovulation in the middle of February and that seasonal gonadal activity terminates in both sexes during the latter part of October.

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"AUDIENCE ENEMIES"

IN SCIENCE for March 13, Dr. DuBois, of Cornell University Medical School, made a vigorous plea for improving the quality of presentation of papers at scientific meetings. He described the common "audience enemies" with such clarity that no possible defense could be offered for the speakers (their number is legion) who fail to recognize that "while effective presentation can never take the place of able investigation, it is the indispensable means of assuring full success to any investigation."[1] However, perhaps the one most common fault indulged in by inexperienced speakers because of stage fright and continued by a large number through sheer inertia is the custom implied by the title, but omitted from the body, of Dr. DuBois's discussion, "the *reading* of scientific papers."

It is bad enough for a teacher to read verbatim to students. They at least have some reason for listening. But for a scientist to address an audience of his peers, no doubt including many of his betters, by literal reading from typed pages, is gross discourtesy. The societies themselves may partly be to blame for the prevalence of this wide-spread "audience enemy." Programs of meetings all too commonly list "papers to be read" or "the following will read papers." Perhaps this time-"honored" custom should not be taken literally and that in such cases "read" really is intended to mean "present." Unfortunately, attendance at scientific meetings would indicate that many of our prominent workers take the literal interpretation and *read* their papers, word for word.

As a consequence, they address their papers and not the audience; they speak in language meant for publication, not oral presentation; they must look up and waste time when a slide appears and then rush back to the typed page after pointing to the screen, in so doing perhaps losing the place. It is virtually impossible for an investigator to make a vigorous oral presentation without looking at and deliberately focussing his attention upon his audience. Reading it is therefore ineffective and, worse, distinctly discourteous. Such a presentation automatically implies that any one could have read the manuscript, but that the investigator did so just to let the audience have a look at him. It also suggests that the speaker is willing to relate his results to his colleagues, but that they are not worth the effort required to prepare an effective oral presentation, utilizing very brief notes, if any.

Aside from papers "read by title only," we might well completely drop the word "read" from our scientific programs and practices.

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THE "audience enemies" Professor DuBois discusses in the March 13 issue of SCIENCE could be effectively controlled if our societies insisted on a rehearsal of their important programs. The officers would have an opportunity of verifying the speaker's ability to be heard and to keep within his scheduled time and might suggest elisions and improvements in arrangement. The radio broadcasters manage to do as much.

GILBERT DALLDORF

A SEVENTH "audience enemy" who should be added to the six described by Dr. E. F. DuBois in SCIENCE for March 13 is the person who reads aloud from his charts or lantern slides every word or number even when "slow readers" can complete such information before the speaker is well started.

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[1] Douglas Johnson, *Jour. Geomorphology*, I: 1, 64, 1938.

Audiences suffer, also, from speakers who discredit themselves by their slovenly pronunciation of basic scientific terms; *e.g.*, expuriment for experiment, chimistry for chemistry, bacterawlgy for bacteriology and vaurus for virus.

Jean Broadhurst

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QUOTATIONS

"TO DO SOMETHING FOR THE WELFARE OF MANKIND"[1]

In these dark days when the world is at war, when democracy is at bay, when no great acumen is required to perceive that a world revolution is in progress—a deep-seated battle between many varying ideologies with no clearly discernible final result—the place, the purposes, the value of the philanthropic foundation may easily come in question. Governments are expending astronomical sums and gigantic efforts for purposes of destruction; of what importance under such circumstances is the welfare of mankind? What values can the few millions of any foundation directed toward such an objective conserve for a future social fabric the pattern of which can be dimly seen, if at all, by the wisest of men?

Is it mere futility to expend money to increase knowledge; to improve the practice of medicine through education and research; to carry out experimental efforts for the improvement of methods for the advance of public health, in days when human life and health are necessarily subject to the needs of war; to devote funds to the improvement of hospital facilities and management; to grant fellowships to brilliant young men that they may be trained for the advance of scientific knowledge; even to attempt to relieve in some slight degree the starvation and misery brought about by the present world upheaval?

The Commonwealth Fund does not believe that such effort is futile. On the contrary, it is the belief of the fund that these undertakings are more important today than ever before. Knowledge and brains still have no substitute. No matter what the future may have in store, knowledge must be conserved and developed, brains must be trained and given opportunity. Not forever will force reign, not always will the organization of society—or its disorganization—preclude the benefits to mankind of scientific discovery, of knowledge, intelligence and understanding. Whatever philanthropic foundations can contribute to the forging of implements for a better day will not be lost. In many conversations during the past two years with able and intelligent leaders in various fields, the outstanding thought has in no instance been one of despair or futility, but rather courage and determination in the belief that now more than ever it is of first importance that the development of potentials for a better and happier world be continued. A few mad men may have seized upon the advances of science for their own destructive ends. But they will pass from the scene. Human living will be reorganized—progress may have been halted; it has not ceased.

Thus it is the duty and the privilege of foundations to "carry on" and to "carry through" to a brighter day. The thought can scarcely be better expressed than in the words of Mr. George W. Gray in the concluding sentences of his tribute to the work of Wickliffe Rose, "Education on an International Scale":

> . . . eclipse is not obliteration. The sun is blackly obscured but it will shine again. Hope feeds on the integrity of law both cosmic and moral. . . . No star is ever lost.

Barry C. Smith

SCIENTIFIC BOOKS

RADIATION THERAPY

The Biologic Fundamentals of Radiation Therapy. By Friedrich Ellinger. Preface by Maurice Lenz. English translation by Reuben Gross. New York: Elsevier Publishing Company, Inc. $5.00.

The biological action of radiation from x-ray and radium varies according to the conditions of application. With x-ray the primary effect is wholly due to the light of short wave-lengths emitted from the anticathode under the impact of the electron beam. These light rays then set free electrons when they are absorbed. With radium, while the alpha rays are usually removed by screening, beta rays are left unless the filter is heavy. Roentgen rays and gamma rays from radiation do not differ except in wave-length. Hence if the action of radiation is due to electrons no differences in biological effect should be expected from x-ray of different voltages or from radium, provided that the conditions of measurement are strictly comparable. This fact has almost never been considered by students of the problem, and the omission has led to the contradictory statements which still exist in the literature, many of which are quoted by the author. For example, as a proof of the different effects of different voltages, the writer quotes from a table by Reissner and Wintz showing that the reddening of the skin giving the so-called erythema dose varies greatly with the filtration of the x-ray. Such an erythema may be produced by 450 r with unfiltered radiation while filtered radiation of higher voltages requires 700 r to give the same reddening of the skin. This, now known to be incorrect, is the type of much early work. The later quotations are from, for example, Stone (*Radiology,* 30: 88, 1938), who states that 25 per cent. more r measured in air can be given of roentgen ray at 1,000 KV than at 200 KV. Both statements are perfectly correct reports of experimental observations, but for instance taking Stone's figures, the back-scatter from the deeper tissues against the skin is 35 per cent. of the impinging dose with 200 KV x-ray, whereas it is only 3 per cent. with million volt x-ray. Hence the difference in effect is easily explainable, for with higher voltage the skin received about 25 per cent. less than with the lower. On the other hand, with Drosophila eggs suspended on thin gauze so that there is no back-scatter, Wood, Exner and Packard have shown that exactly the same doses are needed to kill these eggs with x-ray generated at 10 KV and with all intermediate voltages up to 1,000 KV. On the other hand, the practitioner of roentgen therapy is much more interested in Stone's report than in the results of the Drosophila eggs, for he is desirous of avoiding an erythema, and the higher the voltage, the less likely is an erythema to appear. Many of the older observations which Ellinger quotes were made with different exposure portals and show variations which are also entirely due to differences in scattering, not to some hypothetical differences in the effects of different wave-lengths of radiation. Ellinger quotes Sir Thomas Lewis to the effect that erythema of the skin produced by roentgen rays is due to the liberation of histamine-like bodies. But on the next page, he offers several criticisms of this theory which show that perhaps we still are unaware of the exact process. The effects observed certainly can not be correlated with damage to the cell ferments. Recent studies of the clinical course of erythemas have shown that there are great variations in the periodicity and types, and it is probable that the process is much more complicated than Lewis has suggested. It is interesting in this connection to recall an observation published years ago that the effect of extreme heat and cold gives rise to lesions of the tissues and of the vascular system nearly identical with those produced by x-ray and radium.

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[1] Introduction to the twenty-third annual report of the Commonwealth Fund.

The writer turns after these general discussions of effects observed on the skin to the changes which are produced by the radiation of various organs. Present interest is for the moment centered upon the effects of radiation upon the male and female sex organs and the possible late damage to the offspring. It is very doubtful that the ordinary radiographic exposures used in studying the position of the fetus in the uterus before delivery have any notable effect, although heavy therapeutic radiation has occasionally been noted in human beings to induce extensive lesions in the child. Most of these examples have been drawn from patients who have been rayed for cure of fibromyomata of the uterus and are pregnant at the same time. It is unlikely that a viable child can be obtained with a fibromyoma of any size, but it is wise in general to make a preliminary Aschheim-Zondek test for pregnancy and to empty the uterus surgically before beginning x-ray treatment. A good many surgeons would recommend a hysterectomy under these circumstances in place of irradiation. From all these facts it is evident that temporary sterilization should not be done and if there is any reason for interference with possible future pregnancy, total sterilization should be accomplished either by x-ray or by surgery. Geneticists are agreed that it is doubtful that any notable effects will be discovered in the first generation of offspring after moderate radiation of the gonads, but point out that the second generation of animals shows radiation damage. They also are not in agreement that the moderate quantities of radiation used in diagnosis will cause serious lesions in the second generation; some doubt even the effects of large doses, and point out that inasmuch as most of such heavy doses to the genitals are given for carcinoma of the uterus or tumors of the testicle, the patient is sterilized anyway. It is well, therefore, to wait before making statements concerning irradiation damage until actual observations can be made upon human offspring. The first generation children of rayed individuals are now being married, and within the next twenty years it should be possible to get some useful statistics on this important question.

The author then proceeds to a survey of the effects of radiation upon the various types of malignant tumors, and discusses, in a general way, the application of the fundamental principles on which such treatment is based. Some of the opinions quoted concerning the influence of hormones upon radio-sensitivity are obviously without much scientific foundation, and the writer is a little uncritical in certain fields. For example, it is now certain that preoperative radiation of carcinoma of the breast is of no value, and post-operative radiation of the ovaries is of little therapeutic importance in restraining the growth of a cancer of other organs.

In a short chapter on the effects of corpuscular radiation from radioactive substances the writer quotes the studies of Zadek to the effect that the substances which he injected intravenously in the treatment of leukemias were dangerous to life and not very effective. Ellinger properly refuses to commit himself on the therapeutic value of short-lived synthetic radioactive substances, expressing the opinion that while they are of immense importance in experimental physiology as tracers of various elements in the course of metabolism, their therapeutic value is still unproved. He also holds a very conservative attitude toward the use of neutrons until further information is available.

The subject of the effect of light, especially ultraviolet, upon the general health and in the therapy of disease is very thoroughly presented with interesting observations on photopigmentation drawn from the author's own investigations which tend to show that the presence of pigment alone is not necessarily protective. Photodynamic sensitization is reviewed, and the author makes the interesting statement that in xeroderma pigmentosa, usually assumed to be a light-sensitivity disease, the victim does not always show high light sensitivity and that the actual cause of the disease is still unknown.

In the fifth section the writer again reviews in considerable detail the theoretical notions in regard to the action of radiation which have already been discussed in the opening chapters. The modern literature on the subject is pretty well summarized, but he gets into difficulties in trying to reconcile some of the older work by Glocker and others with that of more recent observers, and the chief value of the discussion lies in showing that to many of these matters we do not as yet know the answer. He then turns to a study of the time factor in radiation and again finds it difficult to reconcile contradictory statements.

The book closes with an admirable bibliography of 1,100 numbers. Most of the references are correct. Only a few typographical errors are noted. There are also excellent author and subject indices. The volume offers a useful survey of a subject about which it is impossible to be dogmatic because of the huge gaps in our knowledge, not only of the underlying biological phenomena, but of the most suitable practical technics. Complete reversal in methods of treatment has taken place since radium and x-ray began to be used widely in the therapy of various diseases, especially cancer, and further advances depend largely upon the slow method of statistical investigation of large numbers of treated patients. Animal experiments have been of value chiefly as showing many of the fundamental laws which govern the action of radiation, but have not been of much use in deciding a host of practical questions which arise daily in the treatment of human cancer. More and more it is becoming evident as experience accumulates that there is no universally applicable technic for the treatment of the large number of diseases in which short wavelength radiation has in some hands proved of great value. The problem is one of practical therapy, not of biological theories.

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MODERN ALGEBRA

A Survey of Modern Algebra. By GARRETT BIRKHOFF and SAUNDERS MAC LANE. 450 pp. New York: Macmillan. 1941. $3.75.

THE rejuvenation of algebra by the systematic use of the postulational method and the ideas and point of view of abstract group theory has been one of the crowning achievements of twentieth century mathematics. Although many of the basic results stem back to Kronecker, Dedekind and Steinitz, the present-day subject is largely the creation of the great woman mathematician, Emmy Noether. "Modern Algebra," by one of her pupils, B. L. van der Waerden, will always remain the classical account of the subject as she conceived it.

Although two or three books on the new algebra have already appeared in English, the present volume appears to the reviewer to be the best all-round introduction to the subject, unique in its clarity, balance, generality and inclusiveness. The size and plan of the book preclude a comprehensive treatment of any one topic; in compensation, the authors are able to say something about nearly every important topic, and they usually succeed in saying the really important things. In addition the book is enlivened by striking applications of modern algebra to other branches of science and made eminently teachable by the inclusion of numerous excellent problems and exercises.

The power of the postulational method is emphasized from the onset by developing the properties of the integers, rationals, real and complex numbers along with the elements of ring theory and field theory from well-chosen postulates. There follow chapters on elementary group theory, vector spaces, linear groups, ideal theory, algebraic numbers, Galois theory and other topics. The geometrical treatment of matrices as linear operators over a vector space is a judicious innovation. The authors even find space for the fundamental ideas of lattice theory, a vigorously growing branch of algebra particularly cultivated by American mathematicians.

In conclusion, the book is emphatically recommended either as a text, an introduction to the literature or a bird's-eye view of one of the great branches of modern mathematics.

MORGAN WARD

Structure of Algebras. By A. A. ALBERT. 210 pp. New York: Colloquium Publications of the American Mathematical Society. 1939.

THIS book, written primarily for specialists in algebra by one of the leading American experts, gives an authoritative account of linear associative algebras which have been the center of interest in algebra for over sixty years. The book is the first in English to utilize fully the new methods introduced by Emmy Noether and her pupils to refine and extend the theory. The preliminary knowledge necessary for its understanding may be found in the Survey reviewed above, or in the author's own text, "Modern Higher Algebra."

The book begins by giving in less than fifty pages all the classical structure theorems. The remaining three quarters of the book are devoted to the numerous new results obtained in the last fifteen years due in the main to Emmy Noether, Richard Brauer, Hasse and Albert himself. Particularly noteworthy are the chapters on the representation theory expounding the methods Albert developed in the theory of Riemann matrices and on the structure of rational division algebras where Albert has been able to avoid the complicated arithmetic of integral sets of an algebra. A final chapter, in which numerous unsolved problems are stated, and an excellent bibliography of the recent literature enhance the value of the book for the student.

The book is written with great clarity and precision and more than fulfils the author's stated purpose in the introduction: to provide "a text on the theory of linear associative algebras . . . (and) a source book for young algebraists." No mathematician at all interested in algebra can afford to miss it.

Morgan Ward

SPECIAL ARTICLES

A NOTE ON THE HYGROSCOPIC PROPERTIES OF CLOTHING IN RELATION TO HUMAN HEAT LOSS

Quite recently we have noted in studies of heat loss from clothed subjects that the thermal effect of moisture changes in clothing can be of large order in relation to human heat production. Such effects may produce confusing results in studies of heat loss under conditions of widely different relative humidity. In changing a clothed subject from a low to a high relative humidity at the same temperature, the effect appears as a plus error in the subject's heat balance. In short, the subject appears to produce more heat than can be accounted for by his metabolic rate. This process is the reverse of evaporation and is due to the absorption of moisture by the clothing with a resulting evolution of heat. In the reverse change, loss of moisture from clothing produces a greater cooling than can be accounted for by the temperature of the environment. Both efforts are transient, and disappear under conditions of equilibrium.

Loss or gain in textile weights due to hygroscopic properties has received extensive study from the standpoint of the industries concerned. The relative humidity of the ambient air has been considered as the critical factor involved and standard regain tables are available which give the weight of moisture picked up (or regained) by 100 parts of a given dry material at equilibrium in an atmosphere of a given relative humidity. These tables show that between 30° and 100° F. air temperature has a minor effect on the ultimate state of equilibrium. In industry attention is given to moisture regain because of its technical importance in spinning and its bearing on true weight of yarn sold or received.

This factor has importance at present because of the interest of physiologists, biophysicists and engineers in developing highly efficient garments for human protection under extraordinary conditions of climatic exposure. In attempting to deal with this problem in our own laboratory we have found no satisfactory references reporting the time curves of these adjustments in textile moisture content. This is the important factor, since it is obvious that the evolution of 100 calories of heat in a garment over a period of 48 hours is of little practical consequence. On the other hand, if a considerable fraction of this heat is released, under certain conditions, over a period of one, two or three hours, the practical effect may be considerable.

For the benefit of others who are concerned with this field, we are reproducing data which will be of assistance in roughly estimating the order of this effect in time. The results apply to a man's woollen garment weighing 1.86 kilos when dry at 70° F.

A temperature and humidity controlled room was available for this study. A Sauter balance of 20 kilo capacity and sensitive to 50 milligrams was used. The garment was originally allowed to come to equilibrium at 70° F and 25 per cent. relative humidity. It was then weighed and packed in an air-tight metal container, while the temperature and relative humidity were being adjusted to a new level. The garment was then unpacked and hung on the balance. Weight gain or loss was recorded continuously at set intervals until full equilibrium was reached (Curve 1). This procedure was repeated, using a new temperature and relative humidity setting for the last half of the operation. The garment was tested over a temperature range from 45° to 90° F. At each temperature a high and low relative humidity was established (77 per cent. and 30 per cent. approximately). The results of nineteen different exposures are shown in Fig. 1. The graph represents gains and losses of weight in the suit for the first six hours. Final equilibrium was reached in most cases within twenty-four hours. The legend referring to each curve indicates the condition at which the suit was in hygroscopic equilibrium when exposure started, and the exposure condition which resulted in a given weight gain curve. For example, the legend for Curve No. 7 reads 90° F, 28 per cent. R.H. → 90° F, 77 per cent. R.H. This means that when the suit was in equilibrium at 90° F and 28 per cent. relative humidity and was then exposed to a condition of 90° F and 77 per cent. relative humidity, it gained weight as described by this time curve.

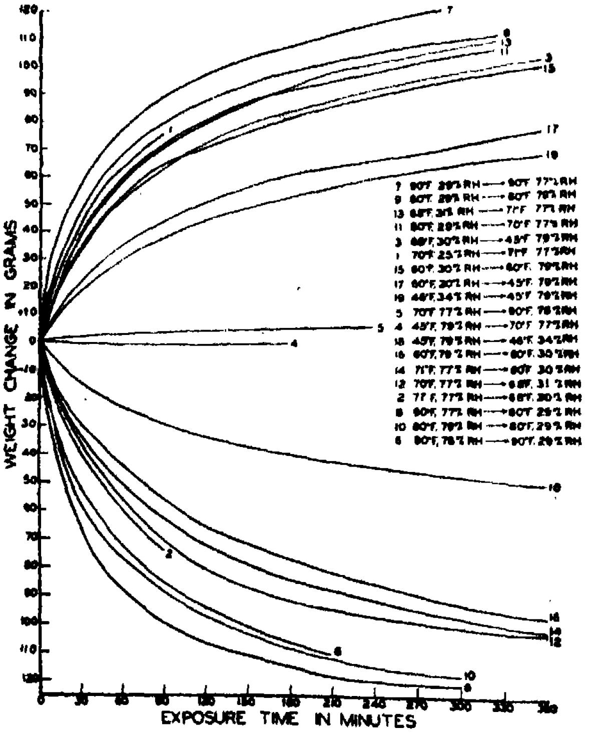

FIG. 1

The significant effect of garment moisture gain or loss on skin temperature and heat balance may be illustrated from the magnitude of the weight changes in the first hour of exposure. For example, in Curve No. 7 again: In the first hour the garment picked up 76 grams of moisture which has a heat gain equivalent of about 44 calories.[1] This value is 50 to 60 per cent. of the resting hourly heat production of an adult man. If one started with a heavy garment of 3 to 4 kilos dry at moderate temperatures, the total heat evolution in the first 2 or 3 hours would obviously be at least equal to the physiological heat production at rest. All curves indicate that more than half the total change in weight takes place in the first two hours of exposure. Another conclusion to be drawn from the figure is that relative humidity influences the weight change far more than temperature, although the effect of 10° rises in temperature is observable for comparable relative humidities. Finally, it may be of some interest to note a hysteresis effect. At a fixed temperature, in varying relative humidity from a given low to a given high value and back to the original low again, the garment gained more moisture before reaching equilibrium at the high humidity than it lost in returning to equilibrium at the original low humidity.

A thorough knowledge of the hygroscopic properties of different materials as well as the thermodynamic implications inherent in the body-clothing system is of considerable importance in designing protective garments for optimum comfort under extreme conditions.

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[1] The calorie equivalent of a 10-gram change in weight is about 5.8 calories.

TREATMENT OF RENAL OSTEODYSTROPHY WITH DIHYDROTACHYSTEROL (A.T.10) AND IRON

RENAL osteodystrophy is a generic name for osseous disorders simulating rickets, osteomalacia or osteitis fibrosa cystica, but originating from chronic renal insufficiency. The most important metabolic defect is poor calcium absorption due to large phosphorus excretion by the bowel as a result of renal insufficiency. Yet vitamin D, specific in promoting calcium absorption in rickets and osteomalacia, is singularly ineffective in renal osteodystrophy. This is true in a series of 5 cases in which detailed metabolic studies were made in this clinic. Vitamin D in ordinary therapeutic doses for prolonged periods orally or intramuscularly or in single massive dose by mouth failed to elicit any significant clinical or metabolic response.

This led us to the use of dihydrotachysterol (A.T.10), an irradiation product of ergosterol, first introduced by Holtz[1] in the treatment of hypoparathyroid tetany. Our experience with A.T.10 in 3 cases of osteomalacia[2] indicates that this compound promotes calcium and phosphorus absorption by the intestine and deposition in the bones, contrary to the earlier view[3] that A.T.10 was not anti-rachitic. In view of the favorable effects on osteomalacia, two of our patients with renal osteodystrophy received by mouth A.T.10 in 3 cc daily doses for 5 four-day metabolic periods while on a high calcium and moderate phosphorus intake. In both cases there was an immediate and progressive decrease of fecal calcium. While calcium appeared in significant amounts in the urine in one case, it remained absent in the other. The net retention of calcium at the height of A.T.10 action during the last period of its administration or the following period amounted to 50 per cent. of the intake. This was followed by a corresponding phosphorus gain due to a diminution of phosphorus elimination both in the stool and in the urine. The serum calcium, low initially in both cases, was raised to normal; and the inorganic phosphorus, high to start with, was reduced to normal during the A.T.10 therapy. Thus in remedying the basic metabolic defect underlying the bone disease in renal osteodystrophy, dihydrotachysterol appears to be highly efficacious, similar to vitamin D in rickets and osteomalacia. However, the effect of A.T.10 lasts for 7 or 8 four-day periods after the therapy is discontinued, in contrast to the long-sustained aftereffect of vitamin D in rickets and osteomalacia. Therefore, to secure substantial remineralization of the skeleton in renal osteodystrophy it would be necessary to administer A.T.10 for a prolonged period of time.

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[1] F. Holtz, H. Gissel and E. Rossmann, *Deutsche Ztschr. f. Chir.*, 242: 521, 1934.

[2] H. I. Chu, S. H. Liu, H. C. Hsu and H. C. Chao, "Calcium and Phosphorus Metabolism in Osteomalacia." XII. A Comparison of the Effects of A.T.10 (Dihydrotachysterol) and Vitamin D. To be published.

[3] F. Albright, *et al.*, *Jour. Clin. Invest.*, 17: 317, 1938; 18: 165, 1939.

Another mode of therapy which we believe to be of interest in renal osteodystrophy is the oral administration of iron salts. It is well known in elementary chemistry that iron combines with phosphate to form insoluble ferric phosphate. That similar reaction takes place in the intestine is indicated by the experimental work[4] showing that iron added to a non-rachitogenic diet of rats produces rickets. Thus iron in large doses is contraindicated in rickets and osteomalacia. However, in renal osteodystrophy with hyperphosphatemia and high concentration of phosphate in the intestine interfering with the assimilation of calcium, the phosphate-precipitating action of iron may be utilized to advantage. Accordingly, the two patients wtih renal osteodystrophy referred to above were given ferric ammonium citrate 6 gm daily for from 5 to 14 metabolic periods. The most consistent changes were a decline of the serum inorganic phosphorus and an ascending tendency of the serum calcium. The phosphorus balance showed a decline due to an increase of stool excretion of phosphorus. The fecal elimination of calcium was usually diminished, giving rise to favorable calcium balance. This increase of calcium retention is most probably the result of the calcium-sparing action of iron in combining with phosphorus in the intestine. Thus from the standpoint of combating phosphate retention and promoting calcium gain in renal osteodystrophy, iron therapy proves effective.

In view of the present unsatisfactory state of affairs in the therapy of renal osteodystrophy, dihydrotachysterol (A.T.10) and iron seem to be rational and useful items in the treatment of such condition. As far as we are aware, the use of A.T.10 or iron in osseous disorder due to renal insufficiency has not been recorded in the literature. This is a preliminary report, and the detailed data will be published elsewhere.[5]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

CONCERNING THE NATURE OF TYPE C BOTULINUS TOXIN FRACTIONS

THE first portions of condensate obtained by use of the standard lyophil apparatus in the dehydration of type C botulinus toxin consist of a high concentration of the thermo-stable fraction of this toxin. Recognition of this fraction in botulinus toxin was announced by Bronfenbrenner and Schlesinger in SCIENCE in 1921, though they gave no method of obtaining it in pure form in quantities sufficient for our study purposes.

This fraction, which for convenience may be designated as A, consists of ammonia salts. It is thermo-stable, and may be obtained in high concentration in almost pure aqueous solution by the method named. No antigenic property has been demonstrated for this fraction and it, therefore, has no specific antibody. Neutralization by type C antitoxin does not occur. Fraction A is a neuro-toxin which acts without delay. Sub-lethal intraperitoneal doses in mice result in nervous irritability for about 30 seconds, followed by what appears to be a complete anesthesia for four to six hours and eventual complete recovery. Thirty intraperitoneal, 18 gram mouse, mld's, administered orally to a three-pound mallard duck, result in a typical case of botulism. The onset in the duck is rapid with paralysis of the third eyelid and complete paralysis within one hour. Complete recovery may occur as early as the 24th hour, though 48 hours is the more common period.

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[4] J. F. Brock and L. K. Diamond, *Jour. Pediat.*, 4: 442, 1934.

[5] S. H. Liu and H. I. Chu, "Renal Osteodystrophy: Studies of Calcium and Phosphorus Metabolism with Special Reference to Pathogenesis and Effects of Dihydrotachysterol (A.T.10) and Iron." To be published.

Fraction A is volatile and escapes from an open vessel on prolonged boiling. It is very stable at room temperature and resistant to bacterial action as opposed to the thermo-labile fraction. Non-sterile, corked samples have been held for a ten-month period at room temperature without loss of toxicity.

It is unlikely that the A fraction ever exists in the free state in nature. Removal of this fraction from the toxin mixture as evolved by bacterial growth results in a remaining fraction which is no longer toxic by oral administration, though it is still toxic by injection. Restoration of the A toxin fraction regularly results in a return to toxicity by the oral administration of the mixture.

Fraction A is destroyed by strong alkali. This fact, coupled with the above findings, may account for the occasional collection of field samples, in semi-arid regions, which are toxic by injection in test animals but which are comparatively *non-toxic* by oral administration in normal doses. Complete separation of the two toxin fractions in nature has not been demonstrated. Reduction of fraction B to powder dryness by the lyophil process results in only partial loss of toxicity by the inoculation route.

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A DARKENING TECHNIQUE FOR INDUCING VIRUS SYMPTOMS IN MATURE AS WELL AS IN GROWING LEAVES

A RECENT article[1] on rapid transmission techniques for stone-fruit viruses was concerned with such devices as pruning, defoliation and girdling of growing plants for the purpose of shortening the incubation period. Incidentally, these techniques also offer promise for producing intensification of disease symptoms and for concentrating viruses in local areas.

Still more recently it has been discovered that the simple device of excluding light from the leaves into which one wishes to move the virus functions in a similar manner to the above but has the additional merit of inducing symptoms also on shoots and leaves that are not growing. To date only the virus of the Yellow-Red or X disease of peach has been tested, but it seems probable that the effects of shading will be generally applicable to other plant viruses.

Darkening the upper half of young rapidly growing peach seedlings for 2 weeks induced disease symptoms, sometimes within 4 weeks from the time the shades were installed. Similarly, darkening one of the branches on older seedlings which had completed their first season's growth induced symptoms within 6 weeks after the shades were installed. Although in these particular experiments the symptoms were not evident before 4 to 6 weeks after darkening, the shades need not be left on more than about 2 weeks and possibly the time of shading can be still further shortened. The growing seedlings were about 20 inches tall, branchless and each received a diseased bud midway on the stem. The older non-growing seedlings had either 2 or 3 branches and each received a diseased bud (sometimes with difficulty because of the cambium condition) near the base of the branches. Thus it was possible to darken either budded or unbudded branches. The shades, consisting of light-proof paper envelopes, had proper provision for ventilation and were held in place by clips attached to a stake.

The movement of the virus is apparently associated with the major movement of carbohydrate as pointed out by Bennett[2] for curly top virus movement in sugar beet and tobacco. Shading a portion of a plant stops photosynthesis in that part and favors the transport of carbohydrate into the shaded part, and if the entering food passes through a part of the stem containing the virus the latter apparently is carried along with the food. By placing the diseased bud somewhere between the shaded region and the food source, which in this case was unshaded leaves carrying on photosynthesis, it has been demonstrated that the virus was carried into the shaded leaves which were receiving food. Therefore, the fact that temporary darkening will induce entrance of the virus and the development of disease symptoms in non-growing as well as in growing tissues affords another important transmission technique to expedite investigations on plant viruses. Since darkening does not involve severe treatment of the plants nor necessitate new plant growth for symptom expression it should prove of value in many situations where pruning, defoliation and girdling can not satisfactorily be used or where it is difficult to induce the formation of new shoots.

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[1] E. M. Hildebrand, SCIENCE, 95: 52, 1942.

[2] C. W. Bennett, *Jour. Agr. Res.*, 54: 479–502, 1937.

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ALLEN, HUGH. *The Story of the Airship (Non-Rigid).* Illustrated. Pp. ix + 74. The Goodyear Tire and Rubber Company. $1.00.

ARLITT, ADA HART. *Family Relationships.* Pp. x + 277. McGraw-Hill Home Economics Series. $2.50.

WEBSTER, LESLIE T. *Rabies.* Pp. vi + 168. Illustrated. The Macmillan Company. $1.75.

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VIRUS INFECTION OF THE MAMMALIAN FETUS[1]

By Dr. **ERNEST W. GOODPASTURE**

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Experience extending over a number of years with experimental inoculation of embryos of incubating hen-eggs has demonstrated a high degree of susceptibility of the developing avian cells and tissues to a number of infectious agents including viruses, bacteria, spirochaetes, fungi and protozoa. It is evident that this avian host in its embryonic stage is much more susceptible to several infections than are adult chickens and perhaps more so than the natural host of particular agents concerned.

Indicative of a greater susceptibility of chick embryos as compared with the adult hen or with a mammalian host is the wide dissemination of focal areas of infection within the body of the embryo inoculated in the chorioallantoic membrane with, for example, the viruses of vaccinia or herpes simplex, neither of which causes more than a mild local lesion in chickens, and ordinarily no conspicuous if any disseminated lesions in mammals. It is not to be inferred, however, that avian embryonic cells and tissues can be infected by any virus or other agent, for they possess toward some agents a complete refractiveness that is of the nature of natural immunity.

Experimenters who have utilized mammalian em-

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[1] A lecture delivered before Section B-17 of the Symposia of the fiftieth anniversary of the University of Chicago, September 26, 1941.

r the study of infection have come to the con-
likewise that these fetal tissues are sometimes
ngly susceptible. Such was the inference of
ıer and Woolpert from the results of inocula-
ı rabbit embryos with vaccinia virus, and of
. pig embryos with the salivary gland virus.

ıs not possible at the present time to explain the
degree of susceptibility of embryos, but even
observations upon some virus lesions of adults
; is indication that young and relatively undiffer-
ated cells sometimes appear to be more propitious
.ia than mature cells of the same kind. If the
ıve metabolic processes of growing cells should en-
nce the susceptibility of a particular environment,
en the embryo obviously might offer a fertile field
or virus multiplication. Another possible contrib-
ting factor is the absence or relatively ineffective use
of a specific immunity mechanism in the embryo. The progress and pattern of an infectious disease in an adult are the resultants of the operation of protective mechanisms that sometimes are very rapid and efficient, sometimes slow and ineffectual.

The indicated, and even in some instances demonstrable, exceeding susceptibility of embryonic tissues to certain infectious agents leads one to a consideration of the phenomena and frequency of prenatal infections in general, and especially of those affecting the human fetus. Instances of prenatal infection are not uncommon and under some circumstances infection of the embryonic tissues is the most conspicuous and dramatic feature of the disease, particularly when it results in abortion. Such is the case, for example, with so-called virus abortion of mares, studied especially by Dimock and Edwards, in which the foal becomes extensively infected with a specific virus, whereas the mother may present little or no clinical evidence of disease. Similarly, brucellosis of cattle results frequently in abortion and the chorionic cells of the fetal placenta are heavily infected with *Br. abortus,* as was shown by Theobald Smith.

In human beings intrauterine infection of the embryo has had its most conspicuous exemplification in congenital syphilis, although virus infections, especially those of the great contagions, like smallpox, measles and chicken-pox, while well known, are rare.

An incomplete review of the literature reveals well-authenticated instances of smallpox, measles and chickenpox in newborn infants. Intrauterine mumps, scarlet fever, erysipelas, recurrent fever, malaria and infection with *E. typhi* have also been reported.

The relative infrequency of infection of the fetus from the maternal disease is indicative of a rather effective barrier between the susceptible tissues of the embryo and the virus- or germ-bearing cells and fluids of the mother. In the case of infective agents carried by the blood stream the determinative barrier in all probability is placental. Rarely if ever does an immune mother permit the passage of infection through the placenta to the fetus. Intrauterine infection is really one concerned with the spread of disease in a susceptible and infected mother to her intrauterine charge.

In the case of an immune mother bearing in her womb the susceptible tissues of her fetus another problem is introduced; namely, the problem of the transplacental transfer of specific immune bodies, which will be touched upon in the discussion.

In the event the mother is infected with a microbial parasite that lives and multiplies in the body fluids and is transported by the blood stream, the pathogenesis of intrauterine infection is probably quite different from that involved in the passage of a virus from mother to fetus. In the former instances the motility of the parasite or a breach of continuity in the placental barrier due to a focus of infection, an infarct or otherwise, might be the determining factors, but in the case of a virus brought into contact with an intact placenta the element of relative susceptibility of the cells which constitute the maternal-fetal union might be of prime importance.

It is my purpose in this lecture to present some recent experimental work that has to do with the susceptibility of the cells of human placentas and fetal membranes, and to discuss some of the observations which Dr. K. Anderson and I have made in relation to problems which I have endeavored briefly to suggest to you.

As a result of interest in devising new means of approach to studies of virus infections Drs. B. Douglas, K. Anderson and I succeeded a few years ago in grafting human skin on the chorioallantois of chick embryos. The grafts became readily established and were well-nourished throughout the remainder of the incubation period. The human cutaneous epithelium under these circumstances was proven to be susceptible to infection by the viruses of vaccinia, smallpox and herpes simplex.

By means of this technique we tested the possibility of infecting human epithelium with material from the vesicles of varicella and herpes zoster because the presumptive viruses of these two diseases have not yet been successfully inoculated in any other than the intact human host. Our experiments were not successful in this respect, and our failure led us to the use of grafts of human fetal membranes similarly implanted on the chick chorioallantois, on the assumption that they might be more susceptible than human skin.

It was our desire to test especially the susceptibility of human fetal cells to the viruses of varicella and zoster, but again we were unsuccessful in inducing these infections in the grafts. However, the grafts themselves and their reaction to inoculation with certain other viruses were of considerable interest, especially in view of the fact that the human fetal membranes have not heretofore, so far as I know, been subjected to study by means of this technique. Before entering into a discussion of our results I should like to call your attention briefly to the procedure which we used.

TECHNIQUE

Human placentas and membranes were received directly from the obstetrical operating room in a sterile pan covered with a sterile towel. With sterile instruments an area of thin membrane was located in the neighborhood of the placenta. A sheet from 5 to 8 cms square was cut out with scissors and spread upon a previously prepared sterile block of cork. Slabs of cork about 10 × 15 × 3 cms were beforehand wrapped in gauze and paper and sterilized. Just before using, the wrapping was removed and the gauze moistened with sterile saline. The gauze was then folded back, exposing the cork surface, and upon this the sheet of membrane was spread with the chorionic surface upward, if that membrane was to be used for grafting. Upon the exposed surface of the chorion lies a layer of decidua which was first stripped off with forceps. There remained a thin sheet of chorion and underlying *amnion*. These were easily separated with the aid of forceps. The sheet of chorion was folded upon itself with the epithelial surface enveloped until used.

The chorionic membrane was then spread out on the cork with the epithelial surface uppermost, and with a sharp scalpel it was cut into 1 cm squares, as many as needed.

Eggs incubated 9 to 11 days were prepared beforehand for opening, by cutting a square window through the eggshell and coating the surface with melted paraffin. They were then placed in the incubator with window up until ready for use.

The window was opened by cutting the shell membrane on three sides with a half spear-point needle and tearing off the dislodged shell from the fourth side. A puncture through the shell overlying the air-sac facilitates dropping of the exposed membrane. A square of human membrane to be grafted was adjusted to the flat end of a small, sterile, searing iron of polished steel, with mesodermal surface exposed. The graft was then placed on the chorioallantois, dislodged from the searing iron and smoothed into place. The window was closed in the usual way with a vaseline-paraffin ring upon which a coverglass was laid. The grafts were fixed at desired intervals by cutting out the chorioallantois to which they were attached, placing it on moist, absorbent paper, and fixing in Zenker's fluid.

The procedure was the same when amniotic grafts were desired. The membranes were placed on the cork always with the surface to be grafted uppermost. The two membranes were then separated, but that which was downward with the epithelium in contact with the cork was always discarded. Bacterial contamination of grafts from the placental membranes prepared in this way was observed only very rarely.

DESCRIPTION OF GRAFTS

The human membranal grafts became attached readily to the chick chorioallantois, and survived throughout the period of incubation, under favorable circumstances. Both chorionic and amniotic membranes are very thin and avascular and nourishment took place apparently by plasmatic circulation; for there was no vascularization. An amniotic graft appears in microscopic sections as a single layer of cuboidal or low columnar epithelial cells resting upon a hyaline basement membrane. Beneath the basement membrane is a delicate layer of collagen containing rare nucleated cells. The chorionic layer is thicker. Its epithelial surface is composed of several thicknesses of its polygonal cells that rest upon a hyaline membrane; beneath which is avascular collagenous tissue, containing few cells, but relatively more than the amnion.

Inoculation of a graft was usually performed about 24 to 48 hours after grafting. A paste of virus-containing tissue was applied directly to the presenting surface of the graft without scarification.

By means of this technique we succeeded readily in infecting grafts of human amnion with the viruses of herpes simplex, variola and vaccinia. In addition to these Dr. Anderson also succeeded in inducing in human amniotic grafts infection with the virus of mare abortion (Dimock and Edwards) which hitherto had not beyond doubt been propagated in the tissues of an alien species.

It was of interest to observe, however, that, in comparison with the amnion, human chorion was very resistant to all the viruses used, and it was only rarely that Dr. Anderson succeeded in infecting the latter with herpes simplex, variola, and vaccinia. In no instance did infection with the virus of mare abortion occur in human chorionic epithelium.

Because embryonic cells of the developing egg are not demonstrably susceptible to infection with the virus of mare abortion, successful infection of human amniotic grafts with it has served to demonstrate, not only the susceptibility of human fetal tissue to this virus, but also that a susceptible tissue grafted upon the non-susceptible chorioallantois of the chick embryo does not lose thereby its susceptibility. Likewise an insusceptible tissue when grafted upon the chorioallantois does not become susceptible to a virus that readily infects the latter. This was shown by grafting human amnion onto the chorioallantois and inoculating it with fowl-pox. Although the infected, hyperplastic and inclusion-containing epithelium of the chick membrane impinged directly upon that of the amnion no evidence of infection of the latter was discernible.

Relative Insusceptibility of Chorionic Epithelium of the Human Fetus as Compared with Human Amnions

For the purposes of the present discussion the difficulty we experienced in securing successful infection of the chorionic epithelium, while amniotic epithelium readily and regularly became infected, is of particular interest. In several experiments in which chorion and amnion were implanted on the same chorioallantois and inoculated with the same material simultaneously and as nearly as possible by the same technique, amnion became infected but chorion remained refractive.

Several possible explanations occurred to us, among them the circumstance that the fetal membranes might have been obtained from women who had acquired an immunity to the particular viruses which we used. Although this did not seem to us a likely explanation of our failure to infect the chorion with the virus of mare abortion, our lack of knowledge of this agent excluded elimination of the perhaps remote possibility of acquired human immunity to it. But we were able to obtain experimental evidence directly opposed to an assumption that acquired antibodies in the chorion, not effectively present in the amnion, might have been the cause of the difference in their respective susceptibilities.

The human placenta is so constructed that the chorionic epithelium is in direct contact with the mother's blood. Rodents, apes and man have placentas of this so-called hemo-chorial type, but in other types of mammals the relationship of the chorion to the mother's blood is not so intimate, for it is separated from the maternal blood by various membranes and supporting tissue, in swine by five layers and in ruminants by four. Therefore in discussing the question of transplacental infection or immunity the utero-placental structure is a most important and perhaps determining factor. I shall have occasion to refer to this difference in placental structure again.

Assuming, however, that maternal immune bodies did come in direct contact with the chorionic epithelium and remained associated with it in the membranal grafts, there is experimental evidence that they would not be effective in preventing infection of the grafts. Evidence against this was obtained from grafts of skin, especially skin from chickens rendered completely refractory to fowl-pox as a result of infection and repeated inoculations with the fowl-pox virus.

Dr. Anderson and I were able to show that such immune skin became quite susceptible to infection by the fowl-pox virus after being grafted on the chorioallantoic membrane of developing hen-eggs, and regained the refractory state when regrafted upon the immune fowl. It appeared from these results that whatever factors contributed to the immune state they became ineffective when the epithelium of the skin was removed from the immune animal and was grafted on the chorioallantois. In the case of antiviral antibodies the probability is that they became diluted and absorbed by the plasmatic circulation in the graft. Another indication of the loss of resistance of tissue to infection by a virus following grafting on the chorioallantois was the susceptibility to vaccine virus of grafts of human skin from persons who were actively immune to cutaneous vaccinia.

These experimental results indicate that if chorionic epithelium should acquire antibodies from direct contact with the mother's blood these antibodies would not be effective in preventing infection should the chorion at the time of inoculation be already grafted upon the chorioallantois of chick embryos.

Another explanation of the apparent relatively firm resistance of chorionic as contrasted with amniotic epithelium is based upon mechanical reasons, and should receive further investigation. In our experiments portions of the fetal membranes were used in which the decidua was firmly attached to the chorion, and was separated by peeling. There is a certain amount of degenerated cells in the cleft between the two, and unless this is removed virus placed upon the surface might not contact the chorionic cells. In one instance in which the decidua was separated and removed as completely as we could, infection of chorionic cells with the virus of herpes simplex did occur. In other instances, however, where cuts were made through the chorion with the iris scissors to expose the underlying cells, and virus was inserted, no infection was observed. In addition to the possible obstructing effect of overlying decidual tissue it appears that the chorionic epithelial cells possess a sort of intercellular matrix which keeps them from intimate contact with each other. This too might operate to prevent the spread of viruses because these agents seem to require an intracellular environment for their multiplication.

Finally, it might be assumed that chorionic epithelium of man is naturally a resistant medium for the viruses which we have used, and for others that infect pregnant women. Recalling the intimate relation of mother's blood to chorionic epithelium of the fetus it is difficult to escape the conclusion that the latter is of a low grade of susceptibility, because in relatively few cases does it appear that the fetus contracts from an infected mother such very contagious diseases as measles, mumps, chicken-pox and influenza. That being the case, it would seem more logical to assume the exceptions to be due to a breach of continuity in the chorion such as by focal areas of infection or by infarcts rather than that in such instances the chorionic epithelium was abnormally susceptible. The results of experimental study of the permeability of placentas to colloidal and particulate materials are also against the presumption that they would be pervious in an uninjured state to viruses and other infectious agents.

TRANSPLACENTAL PASSAGE OF PARTICULATE MATTER

While knowledge is yet too incomplete to permit the formulation of any general theory of permeability of the placenta or to permit decision whether the placental barrier of mammals is a filter or has secretory functions, there is much evidence to show that toxins or foreign proteins practically never pass even the hemochorial placenta, although antibodies readily do so. It seems worthy of emphasis that although foreign proteins in general do not pass through the hemochorial placenta, antibodies (agglutinins, hemolysins, antitoxins, antiviral bodies), whether of foreign origin and introduced passively into the mother, or originating in the maternal tissues as a result of active immunization, do, it appears, pass through readily. According to the estimates of Lewis and Wells and of Boyd, the blood of the human fetus is practically devoid of euglobulin, which indicates that this protein does not pass freely from mother to fetus, although it is often the fraction associated with antibody. The suggestion is obvious that there might either be a selective action of the chorion which permits the passage of a protein antibody, or that the antibody is a smaller and more diffusible molecule than would be expected were it identical with a serum globulin.

The experiments of Wislocki and of others demonstrate how actively phagocytic the cells of the chorionic epithelium of certain animals are for large molecules of colloidal dyes, and it is likely that foreign proteins and particles of other kinds are taken up similarly by these cells.

If this is true it would be difficult to escape the conclusion that human chorionic epithelium which is in immediate contact with maternal blood likewise contacts and probably incorporates particles of certain circulating viruses and other infectious agents. If these cells were as susceptible as some other fetal tissues it would seem likely that fetuses of infected mothers would rarely if ever escape intrauterine attacks of such diseases as measles, smallpox, chicken-pox and yellow fever in which the respective viruses are known to be present at least in certain stages in the circulating blood. As a matter of fact, intrauterine infection with these viruses is at most of relatively rare occurrence, and is observed most frequently in smallpox.

INTRAUTERINE VIRUS INFECTIONS IN HUMAN FETUSES

Of all intrauterine infections with the viruses of the common contagious diseases smallpox seems to be the most common and has been observed for many years, yet no statistical data on the relative frequency have come to my attention. Intrauterine infections with measles and chicken-pox, though rare, are authentically established. Rare reports of infection of the fetus with mumps, influenza, yellow fever, encephalitis and rabies can not be accepted with a great deal of assurance.

VIRUS INFECTIONS OF MAMMALS READILY TRANSMISSIBLE TO THE FETUS PRESUMABLY BY THE MOTHER

There are other virus diseases of mammals, however, that are commonly transmitted to the fetus, and in at least one of them, abortion of mares, the only conspicuous evidence of the prevalence of the disease is the event of abortion of an infected foal.

In human beings the so-called "inclusion disease" (a very poor name) characterized by a wide-spread occurrence of foci in which cells of various organs contain large intranuclear and sometimes cytoplasmic inclusions, has been found in several cases in newborn infants and in the stillborn. The presumptive virus of this infection appears to be similar to those that cause infection of the salivary glands of other mammals, *i.e.*, guinea pigs and mice, the virus nature of which has been ascertained. In guinea pigs the infection is not contracted *in utero*, and in human beings, although a fetus may be infected, there is as yet no information relative to infection of mothers.

Experimental evidence of Markham and Hudson derived from inoculation of guinea pig fetuses with the salivary gland virus indicates a firm resistance of the chorionic epithelium of that species to infection with it. They state that "the remarkable resistance of the chorionic epithelium to infection and injury when surrounded by masses of infected fetal mesenchyme is a striking feature of the placental pathology."

In abortion of mares the mother of an infected foal usually shows little or no evidence of disease, and nothing is known about the pathogenesis of her infection, although the fetus can be infected and resulting abortion caused experimentally by inoculation of the pregnant mare.

In mice lymphocytic choriomeningitis (which sometimes affects human beings) may be a prenatal infection passing from generation to generation, often causing little damage to adults. Pregnant females that continue to carry virus in the blood after clinical recovery transmit the virus to their embryos. The mechanism of intrauterine infection is unknown. Traub speaks of a possible "growth" through the placenta.

BACTERIAL INFECTION OF MAMMALIAN FETAL MEMBRANES

In natural infection through the placenta the chorionic epithelium is in at least one bacterial disease the susceptible rather than the resistant membrane, and its infection determines the picture of the fetal disease that eventuates in abortion. This selective susceptibility of the chorionic epithelium was demonstrated by Theobald Smith in bovine fetal membranes infected with *Brucella abortus*. Only the chorionic membrane is involved, but it is markedly altered by the fact that practically every cell of certain areas is distended to the point of rupture with densely packed masses of the tiny bacilli. It seems probable in this disease that the bacilli enter the utero-chorionic space by way of the blood vessels in the uterine wall and then become phagocytosed by the chorionic epithelium in the cytoplasm of which they find a stimulating medium for their growth. It is quite possible that focal areas of infection of the uterine mucosa serve as distributing centers from which the bacteria gain access to the utero-chorionic space.

Some such peculiar susceptibility of the chorion or other placental cells probably permits the multiplication of the virus of mare abortion, although this has not been demonstrated.

Thus it appears that instead of acting as a barrier to infection the fetal membranes might offer especially favorable conditions for both bacteria and viruses of certain kinds. This fact emphasizes the importance of a consideration of the cells of the membranes, especially the chorionic epithelium, in relation to their relative susceptibilities with respect to specific infectious agents that may attack the pregnant mother.

The fact that the fetal membranes can be grafted on the chorioallantois and inoculated in this detached situation offers an opportunity for the study of specific resistance and susceptibility hardly possible in the intact host, especially in the human host.

Most human mothers are actively immune to the great contagious diseases, which now are largely infections of childhood; and because the fetal chorion is in immediate contact with maternal blood, it is a fortunate circumstance for fetal health that immune bodies readily pass through the placenta in protective amounts to the offspring. In those mammals whose placental structure does not permit passive immunization of the fetus, resistance of the new-born may result from an absorption through the gastro-intestinal tract of immune bodies conveyed by the colostrum and to a less extent by the milk.

Owing to the obvious importance of the placental union in determining whether or not infection of the fetus takes place, it is rather surprising to find so little knowledge concerning placental infection, and the relative specific resistance of placental and fetal membranes.

Our experimental observations concerning the inoculation of human fetal membranes grafted on the chorioallantois of chick embryos indicate that the human chorionic epithelium is naturally a resistant membrane to a number of viruses, and the relative rarity of fetal infection by the active agents of the great contagions leads one to conclude that it is resistant to others which it was not practicable for us to test.

SCIENCE AND WAR

By Dr. PETER L. KAPITSA

MEMBER OF THE ACADEMY OF SCIENCES OF THE U. S. S. R.

WAR demands maximum effort of the belligerents—not only of the army but of the whole organism of the country. Our industry, transport and agriculture must give their utmost; for the greater our output of agricultural produce, munitions and armaments, the swifter our advance to final victory.

War demands unusual effort by creative, scientific thinkers. For instance, factories must simultaneously increase their output and cut down the number of their workers, at the same time that they lose some of their sources of raw materials. Thus, to raise labor productivity by improving technology and the process of production acquires particular importance. Hence, the exceptional value and need of inventive work.

The need to relieve the burden of the transport system makes it essential to harness local resources to serve industry. This in turn necessitates a search for new sources of raw materials or, in the absence of such sources, a search for substitutes. In this field the principal task falls to science.

Finally, armaments too must be constantly improved. The creation of new types of weapons and the perfection of old ones confront science with a whole series of urgent questions that must be answered.

That is why, both in our country and in the countries allied to ours, the war has faced scientific workers with many problems urgently requiring solution.

The whole Soviet people, including the scientists, understands well enough that only by straining ourselves to the utmost can we drive out the hated invaders with least damage to our country. We understand that the struggle now going on is one of life or death, and that the yoke of Fascism would not only turn the collective farmer into a serf under a German landlord, but would deprive the Soviet scientist of his freedom for creative work and of the joy of serving his country and world culture. It is this realization that powerfully spurs our scientists onward.

In peacetime it may occasionally have been possible to censure our scientists for not being invariably able to direct their work into channels most useful for the practical needs of our national economy. It may have been possible to reproach them for that academic abstraction, a hangover of the past, which sometimes marked the scientific work of some researchers. But now the threat to their freedom and their desire to save their country has inspired our scientists and directed their efforts toward the solution of present-day tasks. They are all striving urgently to supply answers to the questions put to them by the war.

Thus, several of our mathematicians who before the war occupied themselves with profound and abstruse problems of mathematical theory, that held meaning only for a small number of contemporary persons, have now successfully centered their attention on immediate problems. One such problem is the application of the conclusions of the modern mathematical theory of probability to the calculation of trajectories of projectiles in flight, thereby improving the accuracy of gunfire.

The wartime work of Soviet scientists may be classified by trends. Some are engaged on problems of broad national-economic significance—the study of sources of raw materials, of substitutes, of utilization of waste products, etc. This work is of particular importance now when we have temporarily lost some of our raw material sources and have had to shift our principal industries far to the east. A special commission of the Academy of Sciences, working at Sverdlovsk, has already achieved important results in this field.

War conditions limit the utilization of some of our resources and prevent importation of many raw materials. To make up the deficiencies with substitute materials is a huge task, mainly handled by our chemists. As an example I cite balsam salve. It is well known that importation of Peruvian balsam—an important component of the Vishnevski curative salves familiar to thousands of our wounded men—involves many difficulties. At present, one of the institutes of the Academy of Sciences is experimenting with a synthetic substitute of which there is no shortage. There is reason to believe its curative properties are not inferior to those of Peruvian balsam.

In another field, our scientists are giving counsel to industry to help it bring its productive forces into full play, to improve the technology of production, to increase output and make more rational use of resources of raw materials. This work comprises no small part of the efforts of our scientists, who frequently pay consultative visits to factories. The scope and multiformity of this work are so great that its full significance is often difficult to appreciate.

Lastly, our scientists are directly participating in the improvement of armaments and defense methods. Stalin has said that our tanks and airplanes are not inferior to the tanks and planes of the enemy. This fact by itself is extremely significant. It is well known that our aircraft industry is still quite young, having been practically non-existent before the Revolution. At first we naturally had to study and copy the achievements of the west in this domain. But we rapidly passed beyond the copying stage, and our aircraft industry long since stepped out on the path of independent, creative enterprise.

To say that Soviet scientists played a decisive role in the success of our aviation is not an exaggeration. After all, the qualities of a modern airplane depend almost entirely on the ability to calculate the profile of the wings and fuselage so that in flight the craft will present least resistance to the air. Experience shows that the slightest deviation from theoretically calculated profiles can considerably reduce flying qualities. These calculations are among the most exacting and interesting of modern aerodynamics. The theoretical work done in this regard by the group of young Soviet scientists produced by the school of Zhukovski and Chaplygin has in many respects left Western European researchers considerably behind. Without these achievements our planes, which have enabled our airmen to beat off the enemy's best squadrons so successfully, could never have existed.

Our scientists are well aware that in producing armaments they must not rest on their laurels for a single moment, that only constant improvement of our weapons brings the hour of final victory nearer and reduces the number of sacrifices that must be made before it is achieved. Boundless possibilities open for scientific thought in this domain. Our science is making use of these possibilities, enhancing the defensive strength of our country. It would be difficult to enumerate all the major and minor undertakings launched in this field and which are already yielding results, even if it were possible to talk about them now.

It is interesting to note that there is not a single field of scientific thought that can not be of value in modern warfare. There is no specialty whose representatives can not put their attainments at their country's service. Physiologists are confronted with such new problems as improving the sight of observers and studying the effects of certain diets and drugs. A peaceful study such as the deciphering of cuneiform inscriptions proved to be of service when it was shown in the last war that experts in cuneiform and hieroglyphic writing were best equipped to decode secret enemy ciphers. Our botanists are working out rules for camouflage, taking account of seasonal changes in vegetation. Our historians are successfully helping fight the unprincipled pseudo-scientific propaganda of the fascists.

The struggle now being waged is giving an exceptional stimulus to scientific thought. The strain and tension caused by war are exposing the weak spots in our economy, technique and organization, showing the points where the state must first of all be assisted, and clearly formulating the demands which society makes on science. Although the war demands great sacrifice and causes much devastation, the upsurge of scientific work which is taking place in our country, and which must develop still more, will not lose its value after the war. The new war-revealed possibilities for unified development of our technique and economy will continue evident in the post-war period as well. History proves that this is true.

It is generally known, for instance, that when the Continental blockade cut France off from the colonies which had supplied it with cane sugar, Napoleon ordered his scientists to search for new sugar sources. Systematic work by French scientists led to the discovery of the method for extracting sugar from sugar beets, now the most widely used method. During the war of 1914–18, the process of nitrogen fixation was introduced and used on a large scale in Germany, which had suffered an acute nitrate shortage. The inventor Haber had not been able to find an industrial application for his discovery before the war. Germany was saved from speedy defeat and, after the war, the synthesis of ammonia spread throughout the world, serving as a basis for obtaining one of the best agricultural fertilizers.

In the course of the present war a number of similar achievements may undoubtedly be expected. For obvious reasons it is impossible to indulge in concrete discussion of the scientific work being carried on in the Soviet Union at the present time. It is already clear, however, that the war will lead to further improvement of our air fleet, will make for better motors, will teach us to achieve high productivity in industry with less workers, and will bring our theoretical, creative thought closer to the practical needs of the country. The sum total of the achievements of our Soviet land will have a tremendous bearing on the development of scientific thought serving world civilization.

OBITUARY

FRANK SMITH

1857–1942

FRANK SMITH, professor emeritus of zoology at the University of Illinois, died at St. Petersburg, Florida, on February 3, 1942, at the age of eighty-five years. He was born at Winneconne, Wisconsin, on February 18, 1857, son of Samuel Franklin and Aurelia Shepard Smith. The parents were of English origin, their ancestors having come to New England at a very early date. When the boy was two years of age his parents moved to New England. His early education was secured in public and private schools of Trenton, New Jersey. In 1870 the family returned to Wisconsin, and until the age of eighteen he attended the Winneconne village school. A marked mathematical turn of mind manifested itself at a very early age. At the age of twenty-one he began earning money to finance a college education. During the years 1879–1885 he was a student, first, in the preparatory department and, later, in the college department of Hillsdale College, Hillsdale, Michigan, receiving the Ph.B. degree in 1885, also the graduating prize in mathematics. While a student in this college he taught mathematics in the preparatory department during the years 1882–1886. A part of the summer of 1886 and the summer of 1887 were spent at the Marine Biological Station at Annisquam, Massachusetts, and the summer of 1891 at the Marine Laboratory of Alexander Agassiz at Newport, Rhode Island.

Following graduation he was appointed professor of chemistry and biology at Hillsdale College, occupying this position during the period 1886–1892. On September 8, 1887, he was married to Edith M. Fox, who died on November 15, 1888. One child, Donald Fisk Smith (1888–1905), was born to them. On July 12, 1890, he was married to Isadora Stamats, who survives him.

Finding his interest in biology growing and feeling the need of further training he did graduate work at Harvard University for a part of the years 1891 and

1893, receiving the degree of A.M. in 1893. In 1892 he was made instructor in biology at Trinity College, Hartford, Connecticut. The next year he was called to the University of Illinois as instructor in zoology. In 1896 he was made assistant professor; associate professor in 1906, and professor in 1913. During the period 1900–1917, he was also curator of the University Museum of Natural History. He taught in summer sessions of biological stations as follows: University of Illinois, 1898 and 1910; University of Michigan, 1911–1914 and 1919–1922; University of Colorado, 1916. The honorary degree of D.Sc. was conferred upon him in June, 1923, by Hillsdale College. In accordance with the University of Illinois retirement plan he became professor emeritus in 1926. He then returned to Hillsdale, Michigan, to live, although all but three of the subsequent winters were spent at St. Petersburg, Florida.

Professor Smith's career as a zoologist began when biology in America was still in its pioneer stage and he lived through that phenomenal period of growth of the science which led to its present maturity. It was a period of rapid change in materials and methods of teaching, scientific techniques and fields of research. To hear him give a connected account of this evolution of biology in America was a unique and informative experience.

The first serious research was begun at Harvard University under the guidance of E. L. Mark and resulted in a paper on the gastrulation of *Aurelia flavidula* (1891, *Bull. Mus. Comp. Zool.*). Events occurred shortly thereafter which changed markedly the character of his investigations. He was invited to become a member of a field party maintained, during the summer of 1893, by the Michigan Fish Commission to carry on a biological investigation of Lake St. Clair. This work marked the beginning of his permanent interests in the problems of inland waters. These interests became further crystallized when in the autumn of the same year S. A. Forbes induced him to go to the University of Illinois on a joint appointment between the Department of Zoology and the Illinois State Laboratory of Natural History. In the spring of 1894 he was made director of the newly organized Biological Station on the Illinois River, an institution jointly supported by the university and the state laboratory for the purpose of making faunistic studies in which special attention was given to the problems of the fisheries. It soon became evident that annelid worms were an important element in the fauna, but since little was known about them in North America, he began investigations on the Oligochaeta and thus his major field of research was initiated. In it he came to be the leading authority in America. His many contributions form the bulk of what is now known of the taxonomy, morphology, distribution and biological relations of the higher Oligochaeta of this continent.

Professor Smith also found other outlets for his diversified zoological interests. About 1915 he began researches on fresh-water sponges, publishing several valuable papers and building up an extensive collection. During a period of twenty years, beginning with 1903, he carried on investigations on the birds of eastern Illinois, with special attention to the relation of spring migration to weather conditions. Several papers were published in this field. Certain other research interests yielded publications, namely, structure of the sacrum and first haemal arch of *Necturus*, hydroids in the Illinois River, relation of fish to oxygen distribution and fresh-water medusae. In addition, there were other writings, such as the well-known chapters on fresh-water Hydrozoa and aquatic Oligochaeta in Ward and Whipple's "Fresh-water Biology."

One of the outstanding characteristics of Professor Smith as an investigator was his meticulous care in the testing of data, his rigorous scrutiny of literature and his insistence that research papers be composed with the utmost regard for accuracy, clarity and brevity. Another characteristic was his unflagging interest in research, manifesting itself in the steady flow of contributions throughout his professional career. Time gaps of any consequential size between contributions are lacking, even during that earlier period when he was afflicted with a serious impairment of eyesight.

As a teacher he was unusually stimulating in an individualistic way which was a part of his personality. Of particular strength was his organization and conduct of field work as a part of courses of instruction. It was his work which early effected an intimate association of the teaching program at the university and researches of the various scientific agencies of the state. He was also responsible for the early appreciation of the value of a museum in the university for teaching purposes rather than for popular exhibition.

As a member of the faculty, he served his university in many important ways. He was entrusted with university responsibilities which called for clear insight and sound judgment. Among his various services to other institutions, he acted for many years as consulting specialist to the U. S. National Museum and to the U. S. Department of Agriculture.

After retirement he found, much to his regret, that conservation of strength and lack of technical facilities necessitated abandonment of research on Oligochaeta. He then turned to his ornithological interests and entered upon an active program of bird banding. This activity, together with a deep interest in the development of the arboretum of Hillsdale College, was a constant source of interest and satisfaction. During the winter months in Florida, he became absorbed in the intriguing ornithology of that state and was active in ornithological organizations at St. Petersburg. For ten years prior to his death he was a member of the board of trustees of Hillsdale College.

Professor Smith's personality was one in which unusual modesty, kindly reserve, deep sincerity and rigid honesty were outstanding features. His code of honorable living was the highest and never deviated. New acquaintances and friendships were acquired slowly and discriminatingly. He had scant patience with the thoughtless, frivolous and superficial, although he possessed a large portion of charity and never refused aid or a courteous hearing to those who approached him for assistance. His attitude towards friends and acquaintances was always charitable and kindly. For careless scientific work he had a supreme contempt and was not reluctant to condemn it in terms which it deserved. At times the undergraduate student stood much in awe of him, but his graduate students, in their more intimate relations, found in him a keen sense of humor, a warm friendliness and a generous sympathy. Those who enjoyed the privilege of the close contacts of a personal friendship had an opportunity to see the real meaning of superior personal honor and integrity.

PAUL S. WELCH

UNIVERSITY OF MICHIGAN

DEATHS AND MEMORIALS

DR. RAYMOND DODGE, professor emeritus of psychology at Yale University, died on April 8, at the age of seventy-one years.

DR. LORRAIN S. HULBURT, emeritus professor of collegiate mathematics at the Johns Hopkins University, died on March 29, at the age of eighty-four years.

DR. WILLIAM WEIDMAN LANDIS, for forty-seven years professor of mathematics at Dickinson College, died on April 8 at the age of seventy-three years.

DR. SUSAN R. BENEDICT, professor emeritus of mathematics at Smith College, who was a member of the faculty for thirty-six years, died on April 8. She was sixty-eight years old.

DR. HARRY A. CARPENTER, specialist in science in the schools of Rochester, N. Y., died on April 5, at the age of sixty-four years.

EDGAR W. TIMM, research assistant in genetics at the Iowa State College, died suddenly on March 26. He had been a Rhodes Scholar at the University of Oxford for three years, 1936–39, before returning to Iowa State, where he worked on bacterio-genetics. He was twenty-six years old.

A BUST of the late Henry Fairfield Osborn, president of the American Museum of Natural History, New York City, was unveiled in the Roosevelt Memorial Building on April 8. Addresses were given by Dr. William K. Gregory, professor of vertebrate paleontology at Columbia University and curator at the American Museum, who for many years cooperated with Dr. Osborn in his scientific work, and by Dr. James Rowland Angell, president emeritus of Yale University, educational director of the National Broadcasting Company.

SCIENTIFIC EVENTS

CHEMICAL WARFARE COURSE

TWENTY-FIVE physicians from the First, Second and Third Defense Regions attended a special course on "Medical Aspects of Chemical Warfare Agents" at the University of Cincinnati College of Medicine, from February 23 to 26, inclusive, under the auspices of the Medical Division of the Office of Civilian Defense with the cooperation of the Chemical Warfare Service of the U. S. Army. It is expected that the class will be repeated for physicians of other regions in the coming months.

Dr. Leon Goldman, assistant professor of dermatology and syphilology in the college of medicine and attending dermatologist at Cincinnati General Hospital, is in charge of the course. The faculty and the subjects given in the first course are as follows:

Milan A. Logan, Andrew Carnegie professor of physiological chemistry and head of the department: Review of Some of the Pertinent Data of the Chemistry of the Chemical Warfare Agents, and Medical Aspects of Some of the Systemic Poisons.

Dr. Robert A. Kehoe, research professor of physiology in the college and director of the Kettering Laboratory of Applied Physiology: Pathologic Physiology and Symptomatology of the Pulmonary Irritants, and Medical Aspects of some of the Systemic Poisons.

Dr. Marion A. Blankenhorn, Gordon and Helen Hughes Taylor professor of medicine: Therapy of Pulmonary Irritant Cases.

Dr. Willard Machle, research associate in applied physiology in the college and assistant director of the Kettering Laboratory: Individual Protection.

Dr. Albert L. Brown, assistant professor of ophthalmology: Eye Injuries from Chemical Warfare Agents.

Dr. Mont R. Reid, Christian R. Holmes professor of surgery: Treatment of Burns from Incendiaries and Other Materials.

Dr. James H. Bennett, assistant professor of surgery in anesthesia: Anesthesia for Chemical Warfare Casualties.

Dr. I. Arthur Mirsky, assistant professor of biological chemistry at the college and director of the May Institute of Medical Research at the Jewish Hospital: Medical and Chemical Aspects of Collective Protection.

Dr. Goldman: Vesicants: Brief Survey of Medical Aspects of the Irritant Smokes, Screening Smokes and Tear Gases; Medical Aspects of Collective Protection and of Decontamination; Medical Aspects of Protection of Food and of Water Supplies and of the Protection of Animals.

Lieutenant A. L. Sparks, of the staff of the Medical Research Laboratory, Chemical Warfare Service, Edgewood Arsenal, Md.: Military Aspects of Chemical Warfare as Related to Civilians.

Dr. George Baehr, chief medical officer, U. S. Office of Civilian Defense, Washington, D. C., gave the opening lecture of the course, explaining its purpose.

It is intended that physicians who have taken this course will be able to set up similar units of instruction in their own localities and will teach both medical and civilian groups.

THE MEMPHIS MEETING OF THE AMERICAN CHEMICAL SOCIETY

The annual meeting of the American Chemical Society will be held in Memphis, Tenn., on April 20, 21, 22 and 23. The Hotel Peabody has been designated as headquarters. Registration will begin on Saturday, continuing through Monday.

The proceedings will open with a general meeting in the Municipal Auditorium. The Honorable Walter Chandler, mayor of Memphis, will give the address of welcome. His address will be followed by the presentation of diplomas certifying to fifty years of continuous membership in the American Chemical Society to Leo H. Baekeland, G. E. Barton, Walker Bowman, Harold H. Fries, Walter Mills Saunders, Albert L. Smith, Alfred Springer, C. P. Van Gundy, Homer Jay Wheeler and Fred G. Zinsser.

The Eli Lilly and Company Award in Biological Chemistry will be presented to Earl Alison Evans, Jr. His address will be delivered on Wednesday before the Division of Biological Chemistry. He will speak on "Carbon Dioxide Assimilation in Animal Tissues." The Borden Award in the Chemistry of Milk will be presented to George E. Holm, who will give the award address, entitled "The Physical and Chemical Aspects of the Libides in Milk," before the Division of Agricultural and Food Chemistry on Thursday.

The following lectures are planned: Henry G. Knight, U. S. Bureau of Agricultural Chemistry and Engineering, on "Cotton—Yesterday, To-day and Tomorrow"; Colonel A. Gibson, Chemical Warfare Service, inspector, Office of Civilian Defense, on "The Chemist's Place in Civilian Defense." Lawrence W. Bass, Mellon Institute of Industrial Research, chairman of the American Chemical Society Committee on Economic Status, will read the report of the committee. There will also be presented from the Office of Civilian Defense Training a motion picture entitled "Fighting the Fire Bomb."

Practically all the divisions of the society will present technical programs throughout the week, and a number of symposia and joint meetings of the divisions are planned. Symposia have been arranged on The Hydrogen Bond and Related Topics, Rare Earths, Trace Elements in Nutrition, Vitamins, Analytical Methods in Organic Chemistry and the History of Chemistry in the South. There will be a round table on the teaching of chemistry on Tuesday afternoon and a student program all day on Wednesday.

There will be trips of inspection to various plants, but these have been greatly curtailed because of the war. Many industries can not permit inspection trips and others must limit attendance in order to avoid interference with production.

THE SCIENTIFIC MEETINGS AT SALT LAKE CITY

The following societies will meet in cooperation with the Pacific Division of the American Association for the Advancement of Science, which will hold its twenty-sixth annual meeting at Salt Lake City from June 15 to 20:

American Association of Economic Entomologists, Pacific Slope Branch, *chairman*, G. F. Knowlton, Utah State Agricultural College, Logan; American Association of Physics Teachers, *president*, A. A. Knowlton, Reed College, Portland, Oregon; American Chemical Society, Pacific Intersectional Division, *chairman*, W. D. Bonner, University of Utah, Salt Lake City; American Geophysical Union, Section in Hydrology, *chairman in charge of arrangements*, Royce J. Tipton, Denver, Colorado; American Meteorological Society, *president*, E. H. Bowie, U. S. Weather Bureau, San Francisco, California; American Phytopathological Society, Pacific Division, *president*, R. B. Streets, University of Arizona, Tucson; American Society for Horticultural Science, Western Section, *chairman*, A. C. Hildreth, U. S. Department of Agriculture, Cheyenne, Wyoming; American Society of Ichthyologists and Herpetologists, Western Division, *president*, Margaret Storey, Natural History Museum, Stanford University; American Society of Plant Physiologists, Western Section, *chairman*, J. Van Overbeek, California Institute of Technology, Pasadena; Association of Pacific Coast Geographers, *president*, Forrest Shreve, Desert Laboratory, Carnegie Institution of Washington, Tucson; Botanical Society of America, Pacific Division, *president*, C. E. Owens, Oregon State College, Corvallis; California Academy of Sciences, *president*, F. M. MacFarland, Stanford University; Ecological Society of America, Western Section, *president*, C. F. Korstian, Duke University, Durham, North Carolina; Oceanographic Society of the Pacific, *president*, R. C. Miller, California Academy of Sciences, San Francisco; Society of American Bacteriologists, Southern California Branch, *chairman*, Anson Hoyt, Medical School, University of Southern California, Los Angeles; Society for Experimental Biology and Medicine, Pacific Coast Branch, *chairman*, C. A. Kofoid, department of zoology, University of California, Berkeley; Western

Interstate Snow Survey Conference, *chairman in charge of arrangements*, George D. Clyde, Utah State Agricultural College, Logan; Western Society of Naturalists, *president*, G. H. Ball, University of California, Los Angeles; Western Society of Soil Science, *president*, L. C. Wheeting, State College of Washington, Pullman.

ELECTIONS TO FELLOWSHIP OF THE ROYAL SOCIETY

ELECTIONS to fellowship of the Royal Society, London, on March 19 are as follows:

Burn, J. H., professor of pharmacology, Oxford; formerly dean of the College of the Pharmaceutical Society; distinguished for his work in physiology and pharmacology and on the principles and methods of biological standardization.

Burnet, F. M., assistant director of the Walter and Eliza Hall Institute for Medical Research, Melbourne; distinguished for his researches in bacteriology, especially on avian and mammalian viruses.

Dixon, M., lecturer in biochemistry, Cambridge; distinguished for his work on tissue respiration and respiratory catalysis.

Dodds, E. C., professor of biochemistry, Middlesex Hospital Medical School; distinguished for his investigations in biochemistry in relation to physiology and medicine and especially in the synthetic production of oestrogenic agents.

Fage, A., principal scientific officer, Aerodynamics Department, National Physical Laboratory; distinguished for his contributions to the experimental study of aero- and hydrodynamics, particularly in relation to turbulent flow.

Fairley, N. H., consulting physician in tropical diseases; Colonel, A.A.M.C.; physician and director of special research, Hospital for Tropical Diseases, London; distinguished for his researches in tropical medicine.

Hall, P., university lecturer in mathematics, Cambridge; distinguished for his contributions to pure mathematics, particularly in the theory of groups.

Hanes, C. S., senior scientific officer, Low Temperature Research Station, Cambridge; distinguished for his researches in botany and biochemistry, and particularly for the first enzymatic synthesis of starch.

Henderson, G. H., professor of mathematical physics, Dalhousie University, Halifax; distinguished for his work in radio-activity and particularly in the investigation of pleochroic haloes.

Hilditch, T. P., professor of industrial chemistry, Liverpool; distinguished for his work on the chemistry of natural fats.

Hindle, E., regius professor of zoology, Glasgow; distinguished for his work in parasitology, and on the cytology of artificial parthenogenesis.

Holmes, A., professor in geology, Durham; distinguished for his work in petrology and the applications of radioactivity to geological problems.

Newitt, D. M., assistant professor in chemical technology, Imperial College, London; distinguished for his work on high pressure technology and for his researches on combustion.

Paterson, C. C., director of the Research Laboratories, General Electric Company, Wembley; distinguished for his work in promoting physical and industrial research.

Roberts, J. K., assistant director of research, Colloid Science Laboratory, Cambridge; distinguished for his investigations by physical methods on adsorption and other surface phenomena of importance in catalysis.

Skinner, H. W. B., Wills research fellow and lecturer in spectroscopy, Bristol; distinguished for his work on the x-ray spectroscopy of the solid state leading to results of importance in the theory of the structure of metals.

Thoday, D., professor of botany, Bangor; distinguished for his researches in plant physiology, particularly those dealing with photosynthesis, causal anatomy and the water relations of plants.

Todd, A. R., professor of chemistry, Manchester University; distinguished for his researches in organic chemistry, notably the synthesis of vitamin B_1 and other natural compounds of physiological importance.

Trueman, A. E., professor of geology, Glasgow; distinguished for his work in paleontology, particularly on the molluscan faunas of the coal measures.

Wilson, A. H., university lecturer in mathematics, Cambridge; distinguished for his contributions to the electronic theory of solids and for his work on the properties of metals.

MEDAL DAY AT THE FRANKLIN INSTITUTE

Two men whose contributions to science have had their influence upon our war industries were among those honored by the Franklin Institute at the annual Medal Day exercises on April 15.

Dr. Jerome Clarke Hunsaker, general coordinator of the Naval Research and Development Board and chairman of the National Advisory Committee for Aeronautics, received the Franklin Medal for his distinguished contributions to aeronautical research and development. Dr. Hunsaker designed the NC type of flying boat which made aviation history on its transatlantic flight in 1919. He also designed the *Shenandoah*, the first large airship to be built in this country, and has played a conspicuous part in the later developments of technical advancement of aviation.

A second Franklin Medal was presented to Dr. Paul Dyer Merica, vice-president of the International Nickel Company of Canada. Dr. Merica has received world-wide recognition for his work in the hardening of alloys and in the development of heat treatment of alloys, so that they have an increased usefulness in the industrial field. His preeminence in the field of metallurgy is as much due to his success in adapting many alloys to commercial purposes as to his discovery of the principle of precipitation hardening, a principle of the utmost importance in these days when alloys find a multitude of applications in diversified war industries.

Honorary membership of the institute was conferred upon Senator George Wharton Pepper "in consideration of his inspiring leadership in the movement to reincarnate in our time the homely virtues" of Benjamin Franklin.

Pure science was recognized in the awards of the Elliott Cresson Medals to Dr. Claude S. Hudson, of the National Institute of Health, and to Dr. Isidor I. Rabi, of Columbia University. The former thus receives recognition for his distinguished investigations into the chemistry of sugars, which has greatly enriched our knowledge of the subject. Dr. Rabi receives the award for the development of the Rabi magnetic resonance method of investigating the nucleus of the atom.

Awards of the Longstreth Medal, for an ingenious construction of a thread grinding machine, were made to Ralph E. and Ernest V. Flanders and to Charles Maxwell Kearns for the application of methods for measuring strains in aircraft propellers under flight conditions.

The frequent uses of concrete in structural work gives importance to the research of Duff A. Abrams, who discovered the fundamental bases for concrete and reinforced concrete mixtures. Mr. Abrams received the Frank P. Brown Medal in recognition of his work.

Three Howard N. Potts Medals were awarded: To Dr. Jesse W. Beams, for his contributions to the problems of high-speed rotation which have met with many applications in the development of ultra-high-speed centrifuges; to Harcourt C. Drake, for the development of a rail fissure detection car which has done much to reduce loss of life and property on railroads, and to Dr. Bernard Lyot, the French astronomer, for his method of studying the sun's corona in the absence of a total eclipse.

The Louis E. Levy Medal for the best paper to appear in the *Journal of The Franklin Institute* has been awarded for the year 1941 to Dr. John Donovan Strong, of the California Institute of Technology, for his paper entitled "On a New Method of Measuring the Mean Height of Ozone in the Atmosphere."

Certificates of Merit were awarded to the Goodyear Tire and Rubber Company for their production of an improved safety tire; to Dr. John J. Grebe, inventor of an ingenious metal sun blind, and to Walter Larkin, of Philadelphia, for an admirable design of a circular knitting machine.

The awards were presented by Charles S. Redding, president, at the meeting of the Franklin Institute on April 15. Senatôr George Wharton Pepper spoke on "Franklin as a Guide in Our Affairs of To-day" at the annual dinner, which was held in the evening.

SCIENTIFIC NOTES AND NEWS

Professor Frederick G. Keyes, head of the department of chemistry and director of the research laboratory of physical chemistry at the Massachusetts Institute of Technology, has been awarded the 1942 Theodore William Richards Medal of the Northeastern Section of the American Chemical Society for "distinguished achievement in chemistry."

The annual medal of the American Institute of Chemists, awarded for "outstanding service to the science of chemistry and the profession of the chemist in America," will be presented on May 16 at the Claridge Hotel, Atlantic City, N. J., to Professor William Lloyd Evans, emeritus professor of chemistry at the Ohio State University, president in 1941 of the American Chemical Society.

Dr. Leo Loeb, emeritus professor of pathology at the School of Medicine of Washington University, St. Louis, was presented on March 3 with the Award of Merit and Gold Medal of the St. Louis Medical Society.

Reno H. Sales, chief geologist of the Anaconda Copper Mining Company, Butte, Mont., has been awarded for distinguished engineering achievement the 1942 Egleston Medal of the Columbia University Engineering Schools Alumni Association. It will be presented to him at the seventy-first annual dinner of the alumni on April 23.

The honorary doctorate of laws was conferred on February 23 on commemoration day at the Johns Hopkins University on Dr. Ross Granville Harrison, chairman of the National Research Council and Sterling professor of biology, emeritus, at Yale University; on Dr. Frank R. Lillie, emeritus professor of zoology and embryology at the University of Chicago, and on Dr. Henry A. B. Dunning, director of the research laboratory and president of Hynson, Westcott and Dunning, Inc.

Professor C. Lovatt Evans, F.R.S., Jodrell professor of physiology at University College, London, has been elected an honorary member of the Sociedad Argentina de Biologia.

It is stated in *Nature* that the Committee of the Athenaeum, London, under the provision which empowers the annual election of a certain number of those of distinguished eminence in science, literature or the arts, or for their public services, has elected to membership Professor P. M. S. Blackett, Langworthy professor of physics, University of Manchester, and T. D. Kendrick, keeper of British and Medieval Antiquities, British Museum.

At the recent New York meeting of the American Society for the Control of Cancer, officers were elected as follows: Dr. Herman C. Pitts, Providence, R. I., *President;* Dr. Frank E. Adair, New York, *Vice-president;* Dr. Cornelius P. Rhoads, New York, *Secretary;* James H. Ripley, New York, *Treasurer,* and Dr. Clarence C. Little, Bar Harbor, Maine, *Managing Director.*

It is announced that Dr. Edward W. Berry, professor of paleontology at the Johns Hopkins University, will retire as dean and provost of the university in order to devote more time to his scientific work. He has been dean of the College of Arts and Sciences since 1929 and provost since 1935. He will continue as professor of paleontology. Dr. G. Wilson Shaffer, professor of physical education, has been named acting dean of the College of Arts and Sciences, and P. Stewart Macaulay, secretary of the university, has been appointed provost. These appointments will become effective in October when Dr. Berry retires.

The *Journal* of the American Medical Association states that Dr. Leslie L. Bigelow, clinical professor of surgery at the Ohio State University College of Medicine, Columbus, has been appointed acting dean of the school. He succeeds Dr. Hardy A. Kemp, dean since September 1, 1941, who as a major in the medical reserve corps of the U. S. Army has been called into active service at the Army Medical School, Washington, D. C.

Albert Eide Parr, professor of zoology at Yale University and director of the Peabody Museum, has been elected director of the American Museum of Natural History, New York, to succeed Dr. Roy Chapman Andrews, whose resignation takes effect on June 1. Mr. Parr was formerly scientific director of oceanographic expeditions at Yale University and is now director of marine research.

T. Roy Reid, who has served as chief assistant to Secretary of Agriculture Claude R. Wickard, has been named director of personnel for the U. S. Department of Agriculture.

Lieutenant Colonel Thomas B. Turner, Medical Reserve Corps, U. S. Army, professor of bacteriology at the Johns Hopkins School of Hygiene and Public Health, has been ordered to active duty in the Surgeon General's Office, Washington, D. C., as chief of the subdivision of venereal disease control.

Dr. Marcus S. Goldstein, research fellow of the Institute for Latin-American Studies at the University of Texas, has returned from a three months stay in Mexico, where a check sample of families was obtained following a study in Texas of the physical anthropology of Mexican families and their American-born descendants.

The Experiment Station Record states that Dr. Lindsey A. Brown, associate agronomist in charge of soil surveys at Colorado State College and Experiment Station, has leave of absence for a year to become special consultant in soils with the Farm Security Administration at Denver, of the U. S. Department of Agriculture. His work at Colorado has been taken over by Dale S. Romine, instructor and assistant in soils.

R. A. Butler, president of the British Board of Education, has been made chairman of the Scientific Advisory and Engineering Advisory Committees in succession to Lord Hankey.

Dr. B. E. Dahlgren, chief curator of the department of botany of Field Museum, Chicago, has returned from a brief collecting trip to Cuba undertaken for the purpose of adding to the palm herbarium. He also investigated potential sources of economic plant products.

Dr. James M. Mackintosh, professor of public health at the University of Glasgow, has returned to Scotland after spending several months in the United States as the guest of the Rockefeller Foundation. Dr. Mackintosh, who was from 1937 to 1941 chief medical officer of the Department of Health for Scotland, acted as consultant to the Medical Division of the Office of Civilian Defense, Washington, D. C., and in that capacity visited many parts of the United States, lecturing and advising on Emergency Medical Service for Civilian Defense.

The annual Christian A. Herter lectures at the New York University College of Medicine were delivered on April 6 and 7 by Dr. Conrad A. Elvehjem, professor of biochemistry at the University of Wisconsin.

Dr. Wallace W. Atwood, president of Clark University and founder of the Graduate School of Geography, lectured at the University of Texas on April 9 and 10. He spoke on "The Geography of Colorado" and on "The Geography of China."

Each year the Sigma Xi chapter of the Iowa State College presents as speaker at one of the regular meetings a member of the staff who has made distinguished contributions to scientific research. In accordance with this custom, Dr. Alfred M. Lucas, associate professor of zoology at the college, has been chosen to address the society. He will speak on "The Effects of Viruses on Tissue Cells."

Dr. Lionel S. Marks, professor of mechanical engineering, emeritus, Graduate School of Engineering, Harvard University, is delivering during April a Sigma Xi lecture at a number of colleges and universities. They are the Polytechnic Institute of Brooklyn, West Virginia University, Washington University, the University of Nebraska, the University of Colorado, the Louisiana State University, the North Carolina State College, the University of North Carolina, Miami University, the University of Michigan and the Illinois Institute of Technology.

The annual meeting of the American Psychological Association will be held at the Hotel Statler and at Harvard University on September 2, 3, 4 and 5, under the presidency of Dr. Calvin P. Stone, of Stanford University. His presidential address will be delivered on the evening of September 4. A panel discussion on "Psychology in Civilian Service," under the direction of Dr. Karl M. Dallenbach, of Cornell University, chairman of the Emergency Committee in Psychology, has been arranged for Wednesday, and on Friday a second panel discussion on "Psychology in Government Service" is planned under the chairmanship of President Leonard Carmichael, of Tufts College, director of the National Roster of Scientific and Specialized Personnel. Plans have been completed for the celebration of the fiftieth anniversary of the American Psychological Association and of the centennial of William James.

The thirteenth annual meeting of the American Association of Physical Anthropologists was held at Harvard University on April 16, 17 and 18. The annual public address was given by Dr. R. C. Carpenter, on the "Behavior and Social Relations of the Rhesus Monkey" (with motion pictures). In addition to papers read before the sections, there were two symposia, one on "Present-day Aims and Interests in Physical Anthropology," presided over by Dr. E. W. Count, and one on "Techniques in Physical Anthropology," presided over by Dr. H. L. Shapiro.

The annual joint meeting of the Wisconsin Museum Conference, the Wisconsin Academy of Science, Arts and Letters, the Wisconsin Archeological Society and the Wisconsin Folklore Society was planned for April 17 and 18 at the University of Wisconsin. All the state societies offered papers in the programs. The annual dinner was held at the University Memorial Union.

The Medical Library Association will hold its forty-fourth annual meeting in New Orleans on May 7, 8 and 9. The hosts are the Rudolph Matas Medical Library of Tulane University, the Orleans Parish Medical Society Library and the Agramonte Memorial Library of Louisiana State University Medical Center. Hotel headquarters will be at the Jung Hotel. The program will feature tropical medicine and southern medical history. The president of the association, Miss Mary Louise Marshall, will preside.

It is reported in *Nature* that the inaugural meetings of the newly formed optical group of the British Physical Society were held on March 6. It is ten years ago since the Optical Society was merged with the Physical Society, and although in this period a good number of meetings have been devoted to optical subjects, there has been a widely expressed desire for the formation of a group for discussions and lectures of a less exacting and critical character than those associated with papers intended as original contributions to science. A preliminary meeting was held in December, 1941, at which a draft constitution was approved. This was adopted at the inaugural meeting. Dr. A. O. Rankine was elected chairman and Dr. L. C. Martin was made honorary secretary.

The U. S. Civil Service Commission announces further open competitive examinations for technologists, with salaries ranging from $2,000 to $5,600 a year. Applicants must not have passed their sixtieth birthday. Junior chemists to perform research, investigative or other work in some branch of chemistry also are needed. The positions pay $2,000 a year. Women especially are urged to apply. The Navy yards, arsenals and other Government laboratories are now employing women in chemical work. Completion of a four-year course in a recognized college with 30 semester hours in chemistry is required. Further information in regard to these positions can be obtained from the Civil Service Commission, Washington, D. C.

Under the will of the late Dr. Menas S. Gregory, formerly professor of psychiatry in the New York University College of Medicine, the sum of $40,000 is left to that institution. Twenty thousand dollars will be used to establish an annual lectureship and the balance will be given toward the endowment of a professorship in the department of psychiatry.

The Indian Society of Genetics and Plant Breeding, which was established at New Delhi in January, has issued the first number of a new journal entitled the *Indian Journal of Genetics and Plant Breeding*. It is edited on behalf of the executive council of the society by Dr. B. P. Pal, Imperial Agricultural Research Institute, New Delhi.

According to the *Journal* of the American Medical Association the new Churchill Hospital is to be opened at Oxford. It will be administered by a group of American surgeons who arrived in England on the first day of the air raids on London. The hospital was built in 1941 and therefore is the first to be built with the horrors of modern warfare in mind. It is so designed that a bomb could do no great damage to the hospital as a whole. The wards are built round a courtyard, each ward having its own air raid shelter. Six hundred patients can be accommodated. The staff comprises twelve American doctors and fifty American and Canadian nurses. Its main function will be reconstruction, of which the two branches will be orthopedic and plastic. A medical service and other types of surgery will be provided as necessity arises. After the war it is intended, if possible, to keep the hospital as a permanent American hospital in relation with the Oxford Medical School. It is hoped that a similar British organization may be initiated in relation with a university in the United States.

DISCUSSION

CYTOCHROME B_2

In the course of isolation of cytochrome *c* reductase from yeast,[1] the presence of a new hemin compound was reported. This observation is of particular interest now because of the report of Bach, Dixon and Keilin[2] of the discovery of a new cytochrome b_2, which, from spectrometric evidence, seems to be identical with the one we have reported. These investigators ascribe two bands to the compound, one at 530 mμ and the other at 557 mμ. The position of the Soret band was not given. The spectrum of an impure sample of cytochrome *c* reductase, both in the oxidized and reduced forms, is given in Fig. 1. In the reduced form the α band of the hemin compound which was present in our preparation was observed at 557 mμ and the Soret band at 420 mμ. Upon oxidation the α band disappears, whereas the Soret band shifts to 410 mμ. The peak at 455 mμ is that of the cytochrome *c* reductase.

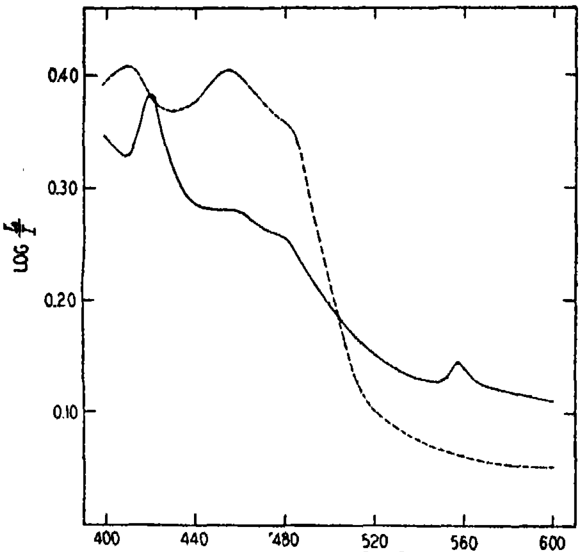

FIG. 1

This hemin compound is reduced by addition of hexose monophosphate, *Zwischenferment*, and triphosphopyridine nucleotide.

ERWIN HAAS
B. L. HORECKER
T. R. HOGNESS

DEPARTMENT OF CHEMISTRY,
THE UNIVERSITY OF CHICAGO
FEB. 17, 1942

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[1] *Jour. Biol. Chem.*, 136: 747, 1940.

[2] *Nature*, 149: 21, 1942.

ON THE WIDTH AND ORIGIN OF BACTERIAL FLAGELLA

The writer was recently examining a photograph of *Aerobacter cloacae* taken with the electron microscope and released by the RCA Manufacturing Company[1] and was struck by its bearing on two controversial points regarding bacterial flagella, namely, the width of a single, unstained flagellum and its origin in the cell.

The thickness of a single, dried, unstained flagellum has been indirectly estimated for a number of bacteria (Migula,[2] Reichert,[3] Meyer[4]). The methods used were based on uncertain and objectionable assumptions. Therefore, one can not help but welcome the heretofore scanty material made available by the electron microscope and hope for more. Accurate measurement of the width of the flagellum of *A. cloacae* were made by drawing a scale, like the one previously used by the writer,[5] on transparent material and by properly superimposing the scale on the photograph of the flagellum. This gave a thickness of 0.02 μ, and an average ratio of 1/22 between the width of the dried flagellum and that of the dried cytoplasm. This ratio is about the same as the one estimated by Migula[2] and is at variance with Meyer's[4] ratio of 1/10. Whether this ratio will hold for other bacteria remains to be seen. Furthermore, by assuming that the faint outer zones of the cells shown in the photograph represent the cell walls, we are justified in assuming that their boundary represents the boundary of the living cells, and that the shrunken cytoplasm has, on the average, about three fourths of its original width (slightly higher than the two thirds found in the literature[6]). On this basis, the width of a single flagellum of *A. cloacae* in the living condition will be about 0.0267 μ or, roughly, 0.03 μ.

Regarding the origin of the flagellum, we have those who believe that it originates from the cell wall and those who believe that it originates in the cytoplasm and extends through pores in the cell wall. The literature has been reviewed by the writer.[6] In the above-mentioned photograph of *A. cloacae,* there is one cell that clearly shows penetration of the faint, outer zone by the flagella all the way to the shrunken mass of the cytoplasm. If this outer zone is the cell wall, and the writer has reasons to believe that it is, then the electron microscope has been instrumental in settling another controversial point regarding bacterial flagella.

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[1] Wallerstein Laboratories Communications, 4: 3, 1941.

[2] W. Migula, "System der Bakterien," 1, 96–138, Jena, 1897.

[3] K. Reichert, *Centralbl. f. Bakt.*, I, Orig., 51: 14–94, 1909.

[4] A. Meyer, "Die Zelle der Bakterien," 119–120, Jena, 1912.

[5] G. Knaysi, *Jour. Inf. Dis.*, 45: 13–33, 1929.

[6] G. Knaysi, *Bot. Rev.*, 4: 86–87 and 99, 1938.

Georges Knaysi

Cornell University

FLUOROCHEMISTRY

With the increasing number of researches and publications devoted to the applications of fluorescence to chemistry, a need is rapidly arising to identify this new branch of science as distinct and apart from related and often confused fields.

Therefore, it seems expedient to propose the name *fluorochemistry* as descriptive of this branch of science. The term fluorochemistry is in order with other terms created to identify highly specialized fields which are still within the boundaries of chemistry and/or physics, *e.g.*, photochemistry, physical optics, and so on.

Jack De Ment

The Mineralogist,
Portland, Oregon

SINO-AMERICAN SCIENTIFIC FRIENDSHIP

In the January 3, 1942, issue of *Nature* there appeared a communication from the British Association of Scientific Workers to American men of science, calling attention to the numerous bonds between them and pointing out the necessity for further cooperation between them and, particularly, their Soviet colleagues in order to achieve the goal of "preserving the scientific heritage of the whole world against the barbarism and obscurantism of Fascist ideology." While the sentiments of this message are undoubtedly welcomed and shared by all American scientists and will strengthen our mutual friendship, we think it of the greatest importance to include and reemphasize at this time our continued feeling of solidarity with the scientific and technical workers of China who have given the world such a magnificent example in contributing to the effort of resistance against brutal aggression.

It has been the good fortune of this country that numerous Chinese have come to study with us and that close ties unite many of the educational institutions of China with our own. We have long admired for their qualities of high character, vigorous personality and intellectual ability the Chinese who have been our fellow classmates, students or professional colleagues. Working with them in our institutions here or in those of China we have realized that there is mutual understanding and that their contribution to civilization continues in an undiminished stream. Our esteem has grown even greater during the past years as we have witnessed the courage with which, in the invaded cities under scrutiny of the enemy or under more adverse physical conditions in the free cities which they have reached often only after long and perilous travel, they have persevered to increase the common store of knowledge as well as to aid in the resurgence of their nation.

We are certain that the scientific workers of Great Britain and Russia join wholeheartedly with us in expressing again to our Chinese colleagues the feeling of comradeship which for many years has motivated our relations and will in the future aid us to create a world where all men may work for the common good, free of threats to security and happiness.

Morris F. Shaffer

QUOTATIONS

THE WORK OF THE ROCKEFELLER FOUNDATION IN 1941[1]

During 1941 the appropriations of the Rockefeller Foundation amounted to $9,313,964. The income of the foundation from investments during the year was $8,734,992. This income was supplemented by a transfer of $600,000 from the principal fund.

The appropriations were distributed for the most part in six major fields, roughly as follows:

Public health	$2,450,000
Medical sciences	2,120,000
Natural sciences	1,271,000
Social sciences	1,227,000
Humanities	1,020,000
Program in China	154,000

A detailed statement of the appropriations made in 1941 appears at the conclusion of this report. Of the money spent during the year, 74 per cent. was for work in the United States and 26 per cent. for work in other countries.

The war, of course, has radically affected the activities of the foundation abroad. In June, 1940, the foundation's Paris office was closed, and the Lisbon office was closed in July, 1941. There are now no foundation representatives on the continent of Europe, but an office is being maintained in London. Late in 1940 the Far Eastern office of the foundation was moved from Shanghai to Manila. At the time of the capture of Manila the head of the office, Dr. M. C. Balfour, was in Kunming. Unfortunately, his associate, Dr. Charles N. Leach, and some of the personnel of the Peiping Union Medical College who were on their way to the United States were in Manila when the city fell. The Peiping Union Medical College was closed by the Japanese authorities early in 1942 and the leading members of the staff were interned.

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[1] Opening pages of the annual report of Dr. Raymond B. Fosdick, president of the Rockefeller Foundation.

MAKING THE PRESENT SERVE THE FUTURE

Confronted with a world in which ruthlessness must be employed to destroy a far more dangerous kind of ruthlessness, organizations like the Rockefeller Foundation, dedicated to the extension of knowledge, can only reaffirm their undiscourageable belief in the ultimate power of reason. As Alvin Johnson says: "The rules of civilization, wrought out on Sinai and the Areopagus, . . . are prior to the bomber and poison gas, and will survive beyond them." The Bill of Rights will outlast "Mein Kampf" just as the scientist's objective search for truth will outlive all the regimented thinking of totalitarianism. Temporarily eclipsed, the proud names of Paris, Strasbourg, Prague, Louvain, Warsaw, Leyden, as well as of Heidelberg and Leipsic and Berlin, will once again stand for the quest for truth; once again will they be centers of candid and fearless thinking—homes of the untrammeled and unafraid, where there is liberty to learn, opportunity to teach and power to understand.

The task which faces all institutions concerned with the advance of knowledge is not only to keep this faith alive but to make certain, as far as they can, that the streams of culture and learning, wherever they may be located or however feebly they may now flow, shall not be blocked. In line with this latter function, in so far as circumstances and limited funds make possible, the Rockefeller Foundation conceives its principal role.

This concern for the future is a matter of stern, practical sense. The specialized talents and abilities that are meeting this emergency and those that will meet emergencies to come are not produced by feverish last-minute activities. No amount of pressure can suddenly create a supply of thoroughly trained and broadly experienced physicists, mathematicians, chemists, biologists, economists and political scientists. These men represent the trained intelligence without which a war can not be won, or a lasting peace achieved. They emerge spontaneously, unpredictably, but irresistibly out of long, patient and sustained effort. Pure research, the clean urge to gain new knowledge, the sympathetic appreciation of imaginative scholarship even when it seems remote and unrelated—these we must steadfastly sponsor or our vital intellectual resources will fail us in the days to come.

It is true, of course, that in an attempt to maintain long-range programs, aiming at the future rather than at the present, no institution can escape the urgencies of the moment. We are all of us in the war and it is idle to pretend that business can proceed as usual. A substantial proportion of the appropriations of the Rockefeller Foundation has some relation to the present emergency. For example, the foundation is furnishing yellow fever vaccine for the Army and Navy; it is speeding up its research in influenza, malaria and typhus, which have a vital bearing on the war; it has financed the microfilming of countless historical records in England that might be destroyed; it has given aid to the development of brain surgery necessitated by war wounds; it has tried to salvage as much of the scholarship of Europe as possible by bringing outstanding university men to the United States.

All this has to do with war or its results. And yet it is possible to say that this type of emergency help has invariably been related to the far target. In trying to be of service in the calamity that engulfs us all the foundation has endeavored to make certain, in so far as it could, that its work had some constructive reference to the world after the war. The development of brain surgery or of techniques for the control of specific diseases has significance for the future as well as for the present; much of the historical material of England is being opened to the students of other countries for the first time; the deposed scholars of Europe are enriching the intellectual life of America; the natural sciences, whether in physics or biology or chemistry, can and will be used to serve a world at peace as well as at war. In all the reordering of human life and habits which the war makes necessary it is still possible, not only in the field of the physical and social sciences, but in the humanities as well, to make the present serve the future.

THE SEARCH FOR UNITY

If we are to have a durable peace after the war, if out of the wreckage of the present a new kind of cooperative life is to be built on a global scale, the part that science and advancing knowledge will play must not be overlooked. For although wars and economic rivalries may for longer or shorter periods isolate nations and split them up into separate units, the process is never complete because the intellectual life of the world, as far as science and learning are concerned, is definitely internationalized, and whether we wish it or not an indelible pattern of unity has been woven into the society of mankind.

There is not an area of activity in which this can not be illustrated. An American soldier wounded on a battlefield in the Far East owes his life to the

Japanese scientist, Kitasato, who isolated the bacillus of tetanus. A Russian soldier saved by a blood transfusion is indebted to Landsteiner, an Austrian. A German soldier is shielded from typhoid fever with the help of a Russian, Metchnikoff. A Dutch marine in the East Indies is protected from malaria because of the experiments of an Italian, Grassi; while a British aviator in North Africa escapes death from surgical infection because a Frenchman, Pasteur, and a German, Koch, elaborated a new technique.

In peace as in war we are all of us the beneficiaries of contributions to knowledge made by every nation in the world. Our children are guarded from diphtheria by what a Japanese and a German did; they are protected from smallpox by an Englishman's work; they are saved from rabies because of a Frenchman; they are cured of pellagra through the researches of an Austrian. From birth to death they are surrounded by an invisible host—the spirits of men who never thought in terms of flags or boundary lines and who never served a lesser loyalty than the welfare of mankind. The best that every individual or group has produced anywhere in the world has always been available to serve the race of men, regardless of nation or color.

What is true of the medical sciences is true of the other sciences. Whether it is mathematics or chemistry, whether it is bridges or automobiles or a new device for making cotton cloth or a cyclotron for studying atomic structure, ideas can not be hedged in behind geographical barriers. Thought can not be nationalized. The fundamental unity of civilization is the unity of its intellectual life.

There is a real sense, therefore, in which the things that divide us are trivial as compared with the things that unite us. The foundations of a cooperative world have already been laid. It is not as if we were starting from the beginning. For at least three hundred years the process has been at work, until to-day the cornerstones of society are the common interests that relate to the welfare of all men everywhere.

In brief, the age of distinct human societies, indifferent to the fate of one another, has passed forever; and the great task that will confront us after the war is to develop for the community of nations new areas and techniques of cooperative action which will fit the facts of our twentieth century interdependence. We need rallying points of unity, centers around which men of differing cultures and faiths can combine, defined fields of need or goals of effort in which by pooling its brains and resources the human race can add to its own well-being. Only as we begin to build, brick by brick, in these areas of common interest where cooperation is possible and the results are of benefit to all, can we erect the ultimate structure of a united society.

A score of inviting areas for this kind of cooperation deserve exploration. Means must be found by which the potential abundance of the world can be translated into a more equitable standard of living. Minimum standards of food, clothing and shelter should be established. The new science of nutrition, slowly coming to maturity, should be expanded on a world-wide scale. The science of agriculture needs development, not only in our own climate but particularly in the tropic and subtropic zones. With all their brilliant achievements the medical sciences are in their infancy. Public health stands at the threshold of new possibilities. Physics and chemistry have scarcely started their contributions to the happiness and comfort of human living. Economics and political science are only now beginning to tell us in more confident tones how to make this world a home to live in instead of a place to fight and freeze and starve in.

All these matters await the future peace. Nevertheless they constitute the stern realities of the present, for as Vice-President Wallace has said: "From the practical standpoint of putting first things first, at a time when there are not enough hours in a day and every minute counts, planning for the future peace must of necessity be a part of our all-out war program."

SCIENTIFIC BOOKS

TRENDS IN PHYSICS TEACHING. SOME RECENT TEXTS

THE art of teaching physics has developed almost in its entirety without benefit of the specialist in educational methods. For explanation, one need look no further than an outline of the subject itself. Hard work on the subject-matter is necessary on the part of almost any one before he can lay claim even to an elementary knowledge of physical principles. Many difficulties, not the first being those of mathematics, confront the student who desires a sufficiently good command of the subject to be able to understand its applications in engineering, chemistry, medicine or geology, to mention but a few fields in which special applications of physics abound. The result of this has been the development on the part of physics teachers of attitudes and methods which have made little concession to the tendency in some quarters to soften educational programs to the level of the average student.

This seeming aloofness of the physics teacher has served as a counter irritant, stimulating much of the best work which has been done in the text-book field in recent years, but it has brought with it a loss of influence with departments of education causing a deterioration or even, in many quarters, an abandonment of high-school physics programs and a consequent loss of students to more advanced courses in physics.[1] The war with its vast new instrumentation, whether for combat with the enemy or for civic protection and defense production, has brought into sharp relief the fantastic discrepancy between the need for and the supply of young people who have a laboratory sense of physics.

The situation might, indeed, be much worse had it not been for the formation in 1933 of the American Assocition of Physics Teachers and the establishment of their journal, the *American Physics Teacher,* now known as the *American Journal of Physics.* This journal has from the first been a forum for the expression of all shades of opinion and experience regarding the teaching of physics. In it have originated far-reaching programs for the improvement of the offering to students, for widening and strengthening its appeal and for the testing and evaluation of the results achieved. A nationwide program of testing of physics students under the joint auspices of the American Association of Physics Teachers and the American Council on Education has served also as a stimulus toward revitalizing the physics course at the college level.

Physics first made its way into the curricula of colleges and schools at a time when classical studies were supreme, and the study of physics had to be justified as mental discipline. The first text-books were as formal as grammars and as unvarying in their content. The infusion of qualities which might cause interest in the subject for its own sake by such writers as John Perry and Poynting and Thomson in England, and by our own well-loved W. S. Franklin, was of great service in the early years of this century, but new discoveries in physics and the constantly accelerating pace of new and important applications continually widened the gap between the developing science and the text-books. In the early twenties "modern physics" began to be incorporated into the books, sometimes as a cream puff for dessert, sometimes sprinkled about for seasoning. The most striking result of the many experiences of the compounders of text-books has been the increasing number of topics deemed of such importance as to demand the attention of the beginning student. Drastic experiments with this material have been carried out by some writers. Numerous new aids to teaching, such as the physics museum, have been developed. There has been a multiplication of objectives for which courses and texts have been designed, with a corresponding variation in choice of topics and character of presentation. Especially marked are the differing degrees of emphasis on practical applications and the more fundamental aspects of the science. The result has been a wealth of new books, new editions and new adaptations of older texts.

The commonest professed objective in writing a text-book in physics is the provision of one suitable for a first course, with relatively little mathematics, yet one satisfying requirements for a certain amount of professional training, and which with a little extra effort might also be used in preparation for engineering or for further science study. In this category are the following:

An Introductory Course in College Physics (revised edition). By N. HENRY BLACK. pp. 734 + viii. New York: The Macmillan Company. 1941. $3.75.

College Physics. By JOHN A. ELDRIDGE (second edition), pp. 702 + xii. New York: John Wiley and Sons, Inc. 1940. $3.75.

College Physics Abridged. By HENRY A. PERKINS. pp. 591 + ix, Figs. 450. New York: Prentice-Hall. 1941. $3.50.

Fundamentals of College Physics. By WILLIBALD WENIGER. pp. 694 + viii. Figs. 340. New York: American Book Company. 1940. $3.75.

Each of these books uses trigonometry and in varying degree provides the student with instructions for problem solving. Black's book is to a high degree pictorial; besides the many reproductions of line drawings and photographs there are many plates, two of them in color. The illustrations cover a great variety of applications and range in time from such subjects as the experiment with the Magdeburg hemispheres to the electron microscope. Each chapter is provided with a summary, a list of references and a set of problems; topics of special interest or of a more advanced nature are sometimes treated among the problems. The book by Eldridge is also profusely illustrated, but with relatively fewer photographs. There is likewise a résumé at the end of many of the chapters and a large number of questions and problems. The style of the book is personal and stimulating, the point of view is that of the physicist. Perkins' book is an abridgement of the author's "College Physics," which "was written with the purpose of offering such complete explanations of principles and theoretical deductions that the student would understand them without assistance from the instructor." The abridgement was accomplished by elimination of material rather than by condensation. No great concessions are made to popular interest. The topics chosen are thoroughly treated and the methods used are such that the book might serve very well as preparation for further courses in physics. Weniger's text is conservative and is no doubt intended primarily as a preparation for engineering. The author does not proceed far with modern physics, but a number of topics in applied physics are given unusual emphasis, as, for example, refrigeration, the elementary theory of the venturi meter and several others. The author takes care to present the theory needed for most of the usual laboratory experiments of the general physics course. Each chapter concludes with a list of suggested laboratory experiments and a goodly assortment of questions and problems.

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[1] See for example, M. H. Trytten, SCIENCE, 94: 387, 1941; also, G. P. Harnwell, *Review of Scientific Instruments,* 12: 571, 1941.

Physics, the Pioneer Science. By L. W. TAYLOR, with the collaboration in the chapters on modern physics of FORREST GLEN TUCKER. pp. xii + 847 + Appendix xliv. Figs. 551. Boston: Houghton Mifflin Company. 1941. $4.00.

General Physics for Students of Science. By R. B. LINDSAY. pp. 534 + xiv. New York: John Wiley and Sons, Inc. 1940. $3.75.

Foundations of Modern Physics. By THOMAS B. BROWN. pp. 333 + xii. Figs. 155. New York: John Wiley and Sons, Inc. 1940. $3.25.

Laboratory Manual of Physics (second edition). By C. M. KILBY. pp. 146 + vi. New York: D. van Nostrand Company, Inc. 1940. $1.75.

The study of the historical development of physics, particularly the setting in contemporaneous thought of the various stages of evolution of the concepts of physics would seem to be a very special subject, one making the most rigorous demands upon the historian and the philosopher as well as the physicist, yet it is becoming increasingly attractive to many of those seeking to enlarge the resources of physics teaching. The most notable example of the use of historical material in the making of a physics text is without doubt "Physics, the Pioneer Science," by L. W. Taylor. Physical concepts are traced from their origin. Free use has been made of the writings of the original discoverers, and in many cases the argument is presented in its first form. This has resulted in a book which will be of great interest to teachers and many general readers. The text is richly illustrated with reproductions of original prints and diagrams forming a collection well devised to arouse the enthusiasm of any one interested in the history of science. As a text for students its success will depend upon the maintenance by the teacher of interest in the historical approach. It will not be sufficient to "adopt" this book as just another text, but the author has eased the task by providing excellent collections of problems where they are called for. Principal divisions of the subject are introduced by several chapters of preliminary historical material so that by the time the student is working with formulae he should be in command of the whole background of development of concept and law. A very large number of the chapters are sufficiently easy and of such general interest that this book will doubtless find use in general or scientific libraries. A list of references to sources includes 291 items. Excellent indices are provided.

"General Physics" by Lindsay is a "thorough and rigorous introduction to college physics for students who intend to pursue scientific careers." It is intended "to serve as a basic introductory text-book for science students who have had mathematics through elementary calculus, and also to provide an intermediate and more rigorous course for such students as have already taken an elementary, descriptive course in physics." As one would expect of this author, great care is taken in the exposition of fundamental concepts, and there are probably few graduate students of the subject who could not read this book with profit. The author has chosen topics with great skill and has managed to put an astonishing amount of good physics in the 520 pages of text. The student who is prepared to use it may well be congratulated on having such a text made available to him. In colleges where the first course is of the usual sort with little mathematics the present text will provide an ideal second-year course for students majoring in science or mathematics.

The term modern physics in connection with the general physics course has come to mean rather definitely the physics of the electron, and includes such matters as the electric and magnetic deflection of cathode rays and of positive rays, the mass spectrograph and isotopes, x-rays and crystal structure, photoelectric effects and more or less concerning radiation and line spectra. The inclusion of this material has seemed necessary to many writers because of the oft-repeated charge that the student completes his college course in physics without coming into contact with those matters which are the concern of present-day physicists. The inclusion has often been awkwardly made, and the choice of subjects included has seldom pleased any one but the author. Moreover, the limitations of time of most courses are such that the modern physics often receives very sketchy treatment with a holiday for the time being from problems and other systematic exercises. Professor Brown's book, "Foundations of Modern Physics," is intended to serve as the text for the fourth unit of a two-year college course in physics; the criterion for choice of material being that it be that which is "at present greenest with new growth." The book opens with an account of electrons and the determination of electronic charge, e/m, positive rays, the mass spectrograph, isotopes, and closes with a discussion of cosmic rays, cosmic ray shower theory and mesons. Between these two chapters the subject-matter ranges through enough physical optics, radiation theory, including electrical oscillations and waves, black body radiation, spectroscopy, x-rays, radioactivity, nuclear physics, to give the student a very good idea of the principal avenues of recent progress. The treatment is largely non-mathematical and can be followed easily by any one who has had a first course in college physics. An abundance of carefully drawn and well-reproduced figures, discussion of many applications of contemporaneous interest, collections of problems, lists of references, are all features which will appeal to the teacher who would supplement his physics course with a systematic treatment of modern physics or who might well give a three-hour year course in modern physics itself. The student who has the mathematics will doubtless prefer a treatment which will more effectively cross the threshold of this fascinating subject.

No part of the physics course has been under closer scrutiny for many years than the laboratory experiments. Many factors contribute to the present-day history of this subject. Laboratory equipment has become continually and ever more rapidly expensive, mass production has robbed much of it of the refinements and precision of an earlier day. Some of the arguments for physics for physics' sake have dwindled in importance. The mere acquisition of laboratory skill is no longer put forth as a principal objective in college physics courses. Nevertheless, there has never been a time when the importance of laboratory points of view and enough familiarity with instruments to remove the first awkwardness with them have been more clearly recognized. In Kilby's "Laboratory Manual of Physics" will be found a typical list of experiments, together with brief notes concerning their theory and directions for performance. The experiments for the most part require inexpensive apparatus and are suitable for a first course.

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SPECIAL ARTICLES

A QUANTITATIVE ANALYSIS OF SULFONAMIDE BACTERIOSTASIS

WOODS'S[1] observations on the relationship of para aminobenzoic acid to the bacteriostatic action of sulfanilamide and sulfapyridine have been amply confirmed and extended by other investigators.[2,3,4] However, his hypothesis that PAB is an essential metabolite of bacteria, and that the inhibition of bacterial growth by the sulfonamides "is due to competition for an enzyme between the essential metabolite and the inhibitor," has not been adequately supported as yet.

We have been engaged for some time in studies concerning the bacteriostatic potency of various sulfonamide derivatives in relation to (1) the minimal effective concentration of the drugs, (2) the type of media employed, (3) the size of inocula and (4) the amounts of PAB required to prevent bacteriostasis. Some of the results obtained are of interest and may shed new light on the mode of action of these compounds.

The bacteriostatic effects of sulfanilamide, sulfaguanidine, sulfapyridine, sulfathiazole and sulfadiazine were observed in two synthetic, inhibitor-free media, one of which affords sub-optimal growth of the test organism, *E. coli*, whereas the other gives growth comparable to that obtained in nutrient broth. The minimal effective concentration (MEC) of each drug was determined as the lowest molar concentration which prevented visible growth over a period of four days with inocula ranging from 25 to 25,000 cells per cc. These concentrations proved to be the same in both media. With all inocula the absolute amount of PAB required to abolish bacteriostasis was found to be the same for the MEC of each drug, as illustrated in Table I. It will be noted, however, that the $\frac{\text{PAB}}{\text{Drug}}$ ratio is inversely proportional to the MEC, which shows that the bacteriostatic potency of a sulfonamide is directly related to the quantity of the drug required to produce bacteriostasis in the presence of a given amount of PAB. Furthermore, the antagonistic effects of PAB and the sulfonamides are apparently related to their concentrations and are independent of the number of bacteria.

TABLE I

THE RELATIONSHIP BETWEEN THE MINIMAL EFFECTIVE CONCENTRATIONS OF SULFONAMIDES AND PARA AMINOBENZOIC ACID

	Minimal effective drug concentration $M \times 10^{-6}$	Minimal amount PAB required to prevent bacteriostasis $M \times 10^{-7}$	$\frac{\text{PAB}}{\text{Drug}}$ Ratio
Sulfanilamide ...	2500	5	1–5000
Sulfaguanidine ..	500	5	1–1000
Sulfapyridine ...	20	5	1–40
Sulfathiazole	4	5	1–8
Sulfadiazine	4	5	1–8

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[1] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.

[2] E. Strauss, F. C. Lowell and M. Finland, *Jour. Clin. Invest.*, 20: 189, 1941.

[3] W. W. Spink and J. Jermsta, *Proc. Soc. Exp. Biol. and Med.*, 47: 395, 1941.

[4] E. Strauss, J. H. Dingle and M. Finland, *Jour. Immunol.*, 42: 313, 1941.

It was observed that the MEC of all the drugs apparently restrained inocula up to 25,000 cells per cc, but that visible growth invariably occurred with larger inocula, even when much greater amounts of the drugs were added to the cultures. In view of these results it was considered possible that the bacteria might be capable of undergoing a *definite, limited number of cell divisions in the presence of any effective drug concentration, regardless of the inoculum employed.* This hypothesis was examined by inoculating decreasing numbers of *E. coli* into media containing a bacteriostatic concentration of sulfathiazole (5×10^{-4} M), counting the number of viable organisms which developed from each inoculum at 6, 12 and 24 hours, and computing the number of cell divisions from the following formula:

$$S = A \frac{(r^n - 1)}{r - 1}$$

where S = count on developing culture
A = number of cells in inoculum
R = factor of increase (2)
N = number of cell divisions.

The results are recorded in Table II, and show that all the inocula underwent almost exactly the same number of cell divisions within the first 6 hours, with the exception of the largest inoculum, which actually divided fewer times. At 12 hours no further significant change had occurred; at 24 hours the number of organisms had diminished.

TABLE II

THE UNIFORM RESTRICTION OF CELL DIVISION BY SULFATHIAZOLE WITH VARIOUS INOCULA OF E. COLI

Inoculum per cc	Count at 6 hours	Number of divisions	Count at 12 hours	Number of divisions	Count at 24 hours
11,800,000	152,000,000*	3.01	170,000,000	3.80	110,000,000
1,180,000	58,000,000*	5.60	64,000,000	5.70	15,000,000
118,000	13,500,000*	6.85	14,000,000	6.86	5,180,000
11,800	1,190,000	6.65	1,600,000	7.08	267,000
1,180	112,000	6.56	110,000	6.54	5,800
118	11,000	6.54	11,600	6.61	210
11.8	1,180	6.64	1,250	6.72	Sterile

* Visible growth.

The conclusion seems warranted that, in the presence of a bacteriostatic concentration of a sulfonamide, bacteria possess the ability to undergo only a certain limited number of cell divisions, regardless of the size of the inoculum. This readily explains why no apparent bacteriostasis may be observed when large inocula are employed, since even a small number of cell divisions will bring such cultures into the range of visible turbidity (*circa* 10,000,000 cells per cc). For example, Table II shows that cultures inoculated with more than 50,000 *E. coli* per cc attained visible growth, whereas those which received smaller inocula remained clear. The number of cell divisions in each culture, however, was approximately the same. Furthermore, the data also offer a reasonable explanation for the well-known but previously obscure finding that organisms subjected to the action of the sulfonamides grow as rapidly as do controls for a few hours before bacteriostasis becomes manifest.

The reason for this phenomenon is as yet unknown, but it seems possible that the bacterial cell contains a substance necessary for reproduction which is synthesized under normal conditions of growth. In the presence of bacteriostatic concentrations of the sulfonamides the synthesis of this substance is prevented, and the organism is forced to distribute its original supply in diminishing amounts to its progeny. After a certain number of cell divisions the quantity of the substance in the individual organisms becomes insufficient to permit further multiplication. PAB may be concerned with this substance in some way. The observed facts indicate that the antagonism between PAB and the sulfonamides is independent of the number of bacteria, but instead is related principally to critical concentrations of these compounds.

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THE RELATIVE EFFICIENCY OF STRAINS OF RHIZOBIUM TRIFOLII AS INFLUENCED BY SOIL FERTILITY[1]

Arachis hypogaea (peanut) was recently tested in the greenhouse to determine how the response to phosphatic and potassic fertilizers is conditioned by the strains of Rhizobia with which the plants are inoculated. The results suggested that certain cultures were better adapted than others to fix nitrogen in poorly nourished plants, although the cultures differed only slightly in efficiency in well-nourished plants. Since the design of this preliminary experiment did not permit reliability to be placed on the small differences observed, a second, more comprehensive experiment was set up, using *Trifolium pratense* (mammoth red clover) and proper cultures of Rhizobia.

In the second experiment five cultures of *Rhizobium trifolii* were compared on clover grown in Plainfield sand receiving four fertilizer treatments. Cultures 209, 238 and 239 were obtained from the University of Wisconsin, and cultures H and D were isolations from old commercial cultures which had been in the laboratory for two years. The four fertilizer treatments were (1) no fertilizer, (2) P, 100 p.p.m., (3)

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[1] Journal Paper No. 9 of the Purdue University Agricultural Experiment Station.

K, 50 p.p.m., and (4) P, 100 p.p.m.-K, 50 p.p.m. Treatments were based on parts per million of elemental phosphorus supplied as $Ca(H_2PO_4)_2 \cdot H_2O$ and elemental potassium supplied as KCl. The soil, when gathered from the field, was deficient in nitrogen, phosphorus and potassium. Commercial seed was surface sterilized, inoculated as desired, and planted, ten seeds to each pot, in steam-sterilized, limed (to pH 6.5) soil. Five-inch pots were used as containers. The experiment was set up in seven randomized blocks. The pots were seeded on April 19, 1941, and harvested on July 15, 1941. Total dry weight and total nitrogen content of the plants were measured.

TABLE I

Culture	Gms. dry wt. produced* in soil fertilized as indicated				Mgs nitrogen produced* in soil fertilized as indicated			
	None	P, 100 p.p.m.	K, 50 p.p.m.	P, 100 p.p.m.-K, 50 p.p.m.	None	P, 100 p.p.m.	K, 50 p.p.m.	P, 100 p.p.m.-K, 50 p.p.m.
209 ...	21.5	19.3	21.5	24.9	515	463	478	604
238 ...	19.3	17.9	22.5	25.5	455	427	500	584
239 ...	18.8	17.5	24.6	27.3	448	414	557	648
H	18.3	16.7	24.0	26.3	461	416	562	636
D	15.5	15.1	19.8	19.4	293	323	419	432
No culture	16.3	15.0	17.1	18.1	307	298	330	324

* Total from the seven replications.

The results of this second experiment (Table I) confirmed the suppositions made from the data of the first experiment. The dry weight and total nitrogen content of plants inoculated with cultures 209 and 239, with and without the addition of potassium, may be taken as an example. When inoculated with culture 209, plants produced a somewhat greater total dry weight and total nitrogen content in unfertilized soil than plants inoculated with culture 239. However, when inoculated with culture 209 dry weight and total nitrogen content of plants do not increase as a result of fertilization with potassium, whereas the increase in dry weight and total nitrogen content of plants inoculated with 239 is quite appreciable. From this it appears highly probable that culture 209 is better adapted to fix nitrogen in potassium deficient clover than culture 239, whereas 239 is better adapted to fix nitrogen in well-nourished plants than is 209. This single example suffices for the purpose of this report.

An analysis of variance of the data on dry matter produced, and subsequent calculation of the mean squares for individual degrees of freedom for interaction between culture and fertilizer treatments, indicates that in the example used above differences are highly significant. In the data on total nitrogen content of the plants, differences in the example cited are highly significant if the data relative to plants inoculated with cultures 209 and 239, with and without potassium, are isolated from the remaining data and analyzed. This procedure is believed justified since there are heterogeneous factors contributing to experimental error in the nitrogen data. For example, several plants receiving no inoculum became contaminated, thus raising the per cent. nitrogen content unduly high. Contamination was less likely in the inoculated groups of plants.

There is no evidence that fertilization with phosphorus changed the relative order of efficiency of the cultures studied.

The occurrence of strains of Rhizobia particularly well adapted to potassium deficient plants is not unexpected in view of what is known of the behavior of Rhizobia. Wilson, Burton and Bond,[2] as well as others, have previously shown that strains of Rhizobia differ in their adaptation to physical and chemical conditions prevailing in given varieties of leguminous plants. For example, two strains of Rhizobia may be of comparable efficiency on one variety of a leguminous plant but differ greatly in their efficiency on another variety of the same species of leguminous plant. However, it seems to us that the demonstration of cultures especially suited to potassium deficient plants has added significance because it suggests the possible development of commercial inoculants especially suited for use with legumes to be grown on particular soil types.

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THE EFFECT OF ARTIFICIAL CHANGES IN THE BRAIN OF MAZE-LEARNING IN THE WHITE RAT

One of the authors has published a number of papers[1, 2, 3, 4] on the effect of injections of the pituitary growth hormone (Antuitrin G and Phyone) in tadpoles and in pregnant white rats on the proliferation of brain cells in the young. In general the mammals at birth showed an increase of about 36 per cent. in weight of the cerebral hemispheres, but only about 19 per cent. in body weight. This differential is further emphasized by the fact that the number of cells per volume of cortex increased 86.5 per cent. over that of the controls. Moreover, the increase in volume was

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[2] P. W. Wilson, J. C. Burton and V. S. Bond, *Jour. Agr. Research*, 55: 619, 1937.

[1] S. Zamenhof, "Possibilities of Increasing the Higher Functions of the Cortex," pp. 1–28. Lancaster: Science Press, 1940.

[2] *Idem, Growth*, 5: 123–139, 1941.

[3] *Idem, Nature*, 148: 3744, 143, 1941.

[4] *Idem, Physiol. Zool.*, 1942. (In press).

70.4 per cent., and that in density 9.27 per cent. All these increases are statistically significant. In those animals that reached maturity (3 to 4 months), the total number of cortical neurones was 38–40.6 per cent. greater than that of the controls. The corresponding figure for cell density was 14.8–27.6 per cent.

The question arose as to whether or not this increase in the number of cortical neurones, when produced artificially, would lead to an increase in maze-learning performance. A maze of 12 culs-de-sac of the Warner-Warden design[5, 6] was used. The experimental group consisted of 9 males and 7 females, and were the progeny of mothers that had been injected subcutaneously each day, from the 7th to the 18th or 20th day of pregnancy, with 1 cc of the commercial preparation of the hormone. The control group consisted of 13 males and 9 females, reared under normal conditions. The animals were approximately 2½ months old when tested, and were of the Sherman strain, secured from the Department of Animal Care, College of Physicians and Surgeons, Columbia University. The total number of cortical neurones showed an increase in the experimental group of 38.4 per cent. in the males and 40.6 per cent. in the females. The cell count was made when the rats were from 108 to 124 days old. There was no significant increase in brain weight, body weight or in the thickness of the cortex.

The increase in the number of cortical cells was not effective in speeding up maze performance. The male experimental group required somewhat fewer trials, and made somewhat fewer errors, but the differences were not statistically significant. The females, on the other hand, learned the maze somewhat less readily than the female controls. We must conclude, therefore, that the artificially produced cells have little or no effect on maze behavior. This conclusion should be corroborated by tests on larger groups before it is accepted finally. It is possible, of course, that such an increase in cortical neurones might be effective in a task representing a higher level of intelligence than maze-learning ability.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PETRI DISH HOLDER FOR MECHANICAL STAGES

WORK in these laboratories has shown the need of a holder which will enable a Petri dish to be moved around under the microscope by the smoothly controlled action of the mechanical stage, thus facilitating observation and expediting such operations as delicate dissection or the precise removal of minute material. Obviously such an appliance must fulfil certain requirements. It must permit rapid easy insertion or removal of the dish, whether base down or inverted, whether covered or open, yet must hold the dish firmly and move it smoothly and precisely around on the microscope stage. It must fit the various types of mechanical stages in common use yet permit their full range of mobility so that any part of the dish may be centered, save, perhaps, the extreme periphery of the four-inch size.

To meet these requirements, as various manufactured devices proved inadequate, the writer, three years ago, developed a device which has served satisfactorily through extensive use in these laboratories ever since.

This holder consists essentially of a spring-steel clip which firmly clasps the dish, and is carried by a frame that fits snugly into the slide holder of the mechanical stage (Fig. 1, A). For the clip, the most exacting part of the device, the chromium-plated steel springs sold by photographic supply stores for clipping over reels of 16 mm movie film have proved most satisfactory since they have adequate strength and a width (½ inch) suitable to the height (½ to ⅝ inch) of the common 3- to 4-inch dishes. For smaller Petri or Stender dishes, pieces of clock springs or of bicyclists' trousers clips are also suitable. The frame, of 16- to 20-gauge sheet brass, has a horizontal base about 3 × 1 inch to fit into the slideholder of the stage, with a crescentic aperture of a size to accommodate the dish

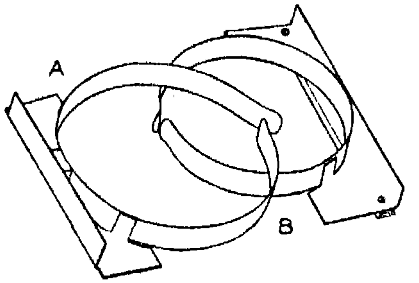

FIG. 1

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[5] C. J. Warden, T. N. Jenkins and L. H. Warner, "Comparative Psychology," Vol. I, p. 242. New York: Ronald Press, 1935.

[6] L. H. Warner and C. J. Warden, *Arch. Psychol.*, 15: 92, 5–27, 1927.

and with 3 ears bent up vertically to serve as a three-point attachment for the clip. A piece of film clip (of suitable length and curvature to encircle snugly the inner valve of the Petri dish) is soldered to these three ears with its ends pointing outward and its lower edge just clearing the stage surface (Fig. 1, A).

In use, this holder, its frame firmly gripped in the fingers of the mechanical stage and its clip snugly clasping the periphery of the dish, will move even heavy agar-filled dishes around on the stage without lagging or jerking and with a smoothness and precision that permit work under high dry magnification.

Although this original type of holder in suitable sizes has proved adequate for most of our needs, various modifications have since been developed for special purposes. For the built-in mechanical stages of such microscopes as the Spencer research model the writer uses a holder essentially similar in construction but with its frame screwed to a beveled brass strip that fits into the stage slot in place of the usual slide-holding fingers (*cf.* Fig. 1, B). A somewhat different holder for built-in stages has been devised recently by Dr. Ernest Runyon, of Agnes Scott College, who, without knowing of the writer's appliance, independently has used the same essential principle. In Dr. Runyon's model the clip of clock spring is attached at one end to a small Bakelite block which is screwed to one of the slide-holding fingers of the mechanical stage (*cf.* Fig. 2, A).

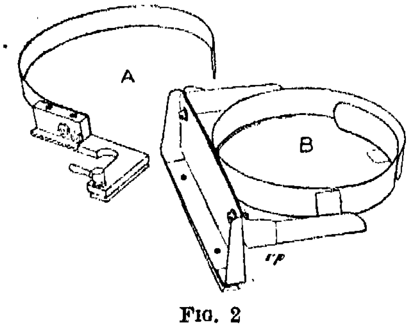

FIG. 2

For holding the uncovered lower valve of a Petri dish upside down so that danger of contamination is minimized during operations on pure cultures growing on nutrient agar the writer uses a holder that supports the valve at a height (about 1 inch) sufficient to permit working with mechanically manipulated needles or pipettes. In this model (Fig. 2, B) the spring clip grips the dish especially tightly and is provided with four lugs projecting slightly from its lower edge so that the dish, although easily inserted, can not fall out. The frame, which extends farther around the dish for greater firmness, is supported by a rigid upright whose beveled base fits the slot of the built-in mechanical stage.

Since these holders have proved helpful in our work, it is hoped that the foregoing description may extend their usefulness to other laboratories.

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THE USE OF DRIED PLASMA FOR THE COAGULASE TEST

THE coagulase test has become an outstanding test for the identification of pathogenic staphylococci.[1, 2, 3, 4, 5, 6, 7] Experiments recently conducted have shown that the test can be satisfactorily carried out, using plasma dried by the cryochem process. Using rabbit plasma (1 per cent. sodium citrate) dried in a modified cryochem apparatus constructed in these laboratories, coagulase tests have been run on a series of coagulase negative and positive staphylococci supplied by Dr. W. N. Plastridge and Dr. J. M. Murphy. Controls were run on each culture, using fresh undried plasma. The technique of Fish[7] was used. Plasma (dried or fresh) was diluted tenfold with physiological saline and inoculated with a large loopful of overnight growths of staphylococci. Perfect agreement between the results with fresh and previously dried plasma has been obtained, clotting having occurred with the strains studied within six hours.

Certain advantages are gained in conducting the coagulase test with dried plasma. Large quantities of plasma can be distributed in convenient amounts, dried and stored for future use. Periodic bleedings at frequent intervals are dispensed with.

The method should facilitate the work of clinical and mobile laboratories.

EDWARD J. FOLEY

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[1] G. H. Chapman, C. Berens, A. Peters and L. Curcio, *Jour. Bact.*, 28: 343, 1934.

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SCIENCE IN MUSIC

By Professor **CARL E. SEASHORE**

THE STATE UNIVERSITY OF IOWA

MUSIC draws upon a number of basic sciences, such as mathematics, physics, physiology, anatomy, genetics, anthropology and general psychology, in the light of prevailing musical theory and practice. It has become the function of the new applied science, the psychology of music, to integrate all these contributions and fit them as a unified function into the theory and practice of music and to initiate specifically designed experiments for the solving of musical problems. The initiative has been taken by psychologists; but as knowledge of the scientific aspects becomes a part of artistic creation and skill, this work of integration will be taken over more and more by musicians, and the distinction between the scientist and the artist will tend to disappear.

On the occasion of a football game at the University of Oklahoma in 1939, I saw seventy-seven marching bands on parade. This represented only a section of the state, and the dust bowl state at that. It meant that music is being taught in the public schools of that state on a surprisingly large scale. Out of these popular bands in showy uniform will come a host of musicians of all kinds and degrees. Music is in the public schools to stay on a large scale. Music in America is in the air, literally and figuratively.

In the last ten years, the State University of Iowa, as one of the American universities which have taken cognizance of this problem, has conferred twelve doctor of philosophy degrees and one hundred ninety-seven master of arts degrees in music. The master of arts is coming to be required of all high-school music teachers. From kindergarten up to the graduate school, music has been taken in with the three r's and their derivatives. As a result we have such relatively new terms as "music educator" and "musicology."

For a certificate to teach music, the candidate must ordinarily be certified for courses in general psychology and educational psychology; and a third requirement, the specific psychology of music, is fast coming in through our teacher-training schools.

In recent years the development of the Acoustical Society of America has brought about a revolution in musical thinking. Research in musical acoustics is being put on a rigidly scientific basis and is making great progress. There is an awakening interest in what is called musicology, the science of music, which has many branches, one of the most active of which is the psychology of music.

In view of this new demand and the new possibilities of a scientific approach to music and scientific foundations for musical education and musical theory in preparation for the teaching and study of music, it is time to inquire, "What can psychology do for music?"[1]

From the time of Aristoxenines and Pythagoras, there have been two attitudes toward music: one is the purely impressionistic attitude of the musician who is not interested in explanations but merely in results as judged by his unaided ear and speculative mind; the other is that of the scientific inquirer, like Pythagoras, who asked, for example, "What are the reasons for the musical scale, and what are its limitations?" The first is the easy and laissez-faire attitude; the second is a critical and scientific attitude which made no great progress until the beginning of the renaissance. Its first prominent organizer, Helmholtz, digested accumulated material from all sources and made fundamental contributions through his laboratory researches, discussed in his epoch-making volume, *Die Tonempfindungen,* in 1862.

Psychology as an experimental science had its beginning only fifty years ago, and in the first half of that period, showed no interest in music. Thus the scientific approach to the understanding and mastery of music is relatively new, and antiscientific musicians are still with us in large numbers.

Psychology gives us a workable insight into the nature of the musical mind and thus lays foundations for the classification of events in musical experience and behavior and for the development of a scientific musical terminology.

The psychology of music is the science of musical experience and behavior. A general knowledge of the structure and function of the musical organism is therefore one of the first requirements in a scientific approach to the study and mastery of music. It helps the student understand what specific features he is dealing with in learning and performing and furnishes the essential basis for the orderly arrangement of observed facts. For example, we learn that the sound wave as the exclusive source of musical tones has only four basic variables; namely, frequency, intensity, duration and wave form. And on the basis of that, it has been found that the musical organism must have four corresponding capacities for hearing all music; namely, the sense of pitch, the sense of loudness, the sense of time and the sense of timbre. This conception simplifies the understanding of the nature and function of the musical mind in that each of these four basic functions apears in such complex musical forms as harmony, melody, dynamics, rhythm, volume and tone quality. It has been shown that all our musical memory, musical imagination, musical thought, musical feeling and emotion, musical action and musical composition may be expressed in these four terms. Thus the classification vastly simplifies the task of the musician and makes the problems of appreciation and performance concrete and specific. The understanding and description of musical design in composition, all the forms of musical expression of feeling, all the techniques in ear-training, all the analyses of musical appreciation, all deviations from the true and regular in artistic forms and all descriptions of types of musicianship and of music in general hinge upon a clear insight into the nature of the functioning of this type of classification. Yet this is but one aspect of classification which the psychology of music contributes to the understanding and description of the musical mind in action.

It organizes the scientific description of musical tones and the means for producing them.

Psychology enables the musician to think in orderly, specific, describable, repeatable and verifiable terms. This is all new to the traditional nonscientific musician. For example, he is interested in tone quality. But what is tone quality? What is its relation to other attributes of tone? What are its determinants? What are the limits, possibilities and means for its mastery? Which, if any, of the accretions of scores of fantastic names for tone quality are significant, definable and usable? These are all psychological questions with a musical meaning which may be taken into the laboratory.

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[1] When I was completing a series of thirty consecutive articles on the Psychology of Music in the *Music Educators Journal,* the editor, recognizing that each of these articles had been an actual contribution to music from the psychological laboratory in the attempt to show what psychology is doing for music, asked me to generalize the series by answering this question. My answer was in twelve statements, which are repeated here in italics. These statements do not mean that psychology has accomplished all these things, but rather that the way has been paved. Nor does it mean that these are the only things psychology can do, but the items listed are limited to those with which I personally have had first-hand and comparatively large experience in the psychological laboratory.

One element of tone quality is timbre, but until very recently no music book revealed an adequate understanding of this concept. Definitions were often meaningless, and a waste of time and efficiency in teaching the mastery of timbre has been atrocious, largely because neither teacher nor pupil knew what it was that he was to develop and did not have any objective standards for orientation. The French pronunciation added to the mystery. Another element of tone quality is sonance. We had no name in music for this vital concept of tone quality until about fifteen years ago. Now tone quality can be explained in terms of timbre and sonance to satisfy the members of the Acoustical Society of America, the musicologists, the intelligent teachers and students of music and scientists in general. Discriminative hearing and appreciation and mastery in the control of tone quality rest upon a correct terminology and insight into the nature of the concept.

The musician can now look at the graphic picture of the tone spectrum of his violin and the graphic performance score which is recorded with a camera and shows in minute detail exactly how he performed in a given rendition. To accomplish this, psychology accepts the physicist's account of tone production as exemplified in various instruments, the physiologist's account of the vocal mechanism and the human ear, the geneticist's theory of inheritance and development, the anthropologist's account of evolution in the human race and the psychologist's account of principles of hearing. Each of these contributions thus helps the musician to know and describe a certain characteristic of voice or instrument and analyses and specifies the best means for artistic tone control and the acquisition of musical skills. To facilitate this for experimental purposes, tone generators are now available which enable us to produce any kind of tone desired according to specifications and to describe such tones quantitatively. Applied science can now improve the violin or any other instrument, build entirely new models or effect new ensembles of instruments.

It gives us an orderly insight into the nature, scope and limitations of musical hearing and appreciation.

The child says with satisfaction, "I see with my eyes and hear with my ears." That attitude, until recently, satisfied many a student and teacher of music. But there is now a very elaborate and serviceable experimental psychology of hearing, both pure and applied, for which we find countless applications in the hearing, appreciation and performance of music. The musician is now becoming interested in knowing and being able to state exactly what it is in the musical tone that he hears, appreciates, tries to perform and intends that the listener shall hear. He finds available an elaborate and technical system of laws of hearing, of which the most important are the laws of illusion in hearing. He finds that if it were not for the operation of law in illusion there could hardly be any real music. He finds that the relation between the physical sound and the sound as heard is not 1:1 and that a series of conversion tables for this relationship are of vital importance in hearing. He finds that the observation of acoustic principles determines the carrying power and the pleasantness or unpleasantness of his tone. His understanding and artistic rendition rest upon observance of these laws. The composer and the performer must be guided by definite laws of phonetics and acoustics. Musical hearing and musical criticism must take them into account. In other words, the incoming insight, interpretation, description and mastery of music hinge upon the command of principles of hearing; and the musician finds that musical education is in large part a systematic training of a discriminating ear.

It enables us to analyze and evaluate musical talents as a basis for guidance in musical education, vocational and avocational.

Musical talent is inherited in various kinds and various degrees. There is not one, but a hierarchy, of musical talents, many of which can now be analyzed clearly and measured with precision. In this equipment, nature is prolific. Education and refinement build upon selected native capacities; but most frequently a large part of this inherited endowment is lost for want of cultivation.

The magnitude of individual differences is conspicuous in music. Yet the problem in music education is to deal with each individual difference with proper recognition of the total personality in the total situation. One of the unfortunate fallacies promulgated by many music teachers is the idea that, while many children inherit a musical mind, it is their function to develop it in those children who have little or no such inheritance. But when the public school music teacher now makes a survey of musical talent in the school and finds that of two equally intelligent pupils one may have more than one hundred times as fine a sense of pitch, sense of rhythm, sense of time or sense of timbre as the other and that these are relatively independent variables so that a pupil may stand high in one and low in another, he faces a stubborn fact which he can not ignore in selecting instruments, registering pupils for training, interpreting success or failure and laying foundations for praise and blame.

It has been found that in the human races of the world to-day and in the various culture levels of civilized people, there is but little difference in the average of the elemental capacities for musical hearing; but within any such group, there is an extraordinary range of difference among individuals. There is as wide a distribution of the gift of music among the primitive South Sea Islanders as there is in the families of the social register; and in both groups the highly gifted are relatively rare and the non-gifted are in abundance. When we find that these differences in capacity are fairly independent of age, intelligence, training and culture or racial origin, we face new problems in music. Native talent is the *capital* which it is the business of the music educator to invest. He must therefore know what it is and how to make the best investment. Psychology has furnished the methods and means for such measurement, not only at the sensory and motor levels but also at the higher creative levels.

It furnishes the technique for the measurement of musical achievement by the analysis and objectifying of goals as a means of motivation in training.

The techniques developed for the measurement of musical talent are now carried into the field of the analysis and measurement of musical achievement. It has become possible to set up definite musical objectives as specific goals of achievement in various stages of training and to measure progressive achievement in the work toward these goals. Thus a pupil is furnished a check list of specific concepts, skills and critical judgments which are to be acquired, and may enjoy the privilege of knowing in specific terms what progress he is making from time to time. This is a powerful element in motivation and the attainment of efficiency through instruction. This organization of scientific measurement of musical achievement is going to revolutionize the musical curriculum. There will be a general housecleaning for discarding the non-essential, the undefinable and the incongruous; and the music educators are now joining in cooperative movements to determine the minimum essentials and the order of their development in terms of scientifically defined concepts.

It enables us to organize musical training in terms of a growing body of principles in educational psychology.

Educational psychology has revolutionized teaching in all other public-school subjects. Music educators and psychologists are now attempting to glean nuggets from the current literature on the various aspects of the psychology of learning in order to select and organize those general facts in educational psychology which have a bearing on the art of instruction in music. Music teachers are fast joining the ranks of those who conduct psychological experiments in the actual musical situation. It has been the function of psychology to stimulate and facilitate this movement.

It paves the way at all levels for principles of musical criticism and a logical award of praise and blame.

Historically, musical criticism has generally been impressionistic and unscholarly. But it is no longer satisfactory to fill the music columns with laudatory or condemning slush, popularly conventional, prejudiced, often subsidized. The psychology of music has begun to pave the way by furnishing the tools for logical criticism and discriminating judgment in terminology standardized for the art. Considerate and judicious criticism is one of the most promising incoming means for motivation or rightful discouragement from the child in the elementary grades to the professional on the stage. It is not only pedagogical but humanitarian to recognize individual differences in the degree and kind of musical capacity at all levels in the award of praise and blame. We can not expect equal achievement from all the children in a given grade in school; and in assigning credit for work, the modern teacher faces a new problem—the attainment of a fair balance in giving credit or discredit for achievement in relation to capacity for achievement and specific outstanding fortes and faults.

It makes possible the use of performance scores for the detailed analysis and quantifying of artistic elements in musical performance.

The greatest single contribution made in the recent advances of the psychology of music lies in the development of musical phonophotography and the invention of the graphic musical performance score, based on the objective recording of individual sound waves in the musical tone. The phonographic recording had to be supplemented by a series of phonophotographic processes. The musician can now go into the recording studio and perform with voice or instrument where, in addition to a permanent phonographic record, a series of synchronized cameras reproduce every aspect of each individual sound wave so that each note can be reconstructed in minute detail much finer than the ear can hear. This recording may be done in a dead room, which eliminates from the musical performance all those characteristics which are due to extraneous sounds and the acoustic characteristics of the music room. Thus in the time that it takes to sing a song, whether it is sung on the stage, in the radio studio or in the laboratory, we obtain a moving picture record which contains thousands of items of musical significance.

But the mastery of this type of recording revealed the necessity of a new type of language for musical performance. This has taken the form of what is known as a performance score, in which the actual rendition of each note is graphed in such detail as may be desired in terms of clearly defined characteristics of the tone as rendered. This graphic performance score is a brand new language with a systematized series of symbols representing defined concepts for musical performance quite analogous in its significance to the language and symbols of mathematics or biology. In terms of such a performance score, any specific element in the character of the performance may be isolated for analysis and measurement. The musician will see revealed in the score an astonishing number of features of which he was not aware. The interpretation given by various artists may be compared and criticized, and new features in the phonographic record for the ear will be recognized when they have been revealed by the cameras. For the preservation of primitive music, for the criticism of great artists and for educational purposes, the resources of the performance score are inexhaustible and open up a new area of interest and proficiency in music.

Individuality in the art of musical interpretation lies largely in artistic deviation from the true, the rigid and the uniform as represented by the musical score. The performance score represents precision measurements of all forms and degrees of artistic deviation expressing artistic license, judgment and skill.

It enables us to set up norms of prevailing musical achievement and to show by experiment how these norms for attainment could and should be refined.

We do not have and do not desire fixed standards or norms in any element of musical excellence. There must be room for artistic individuality, and there are countless elements which may contribute to the goodness or badness of a voice or an instrument. But the psychology of music has introduced techniques, especially through the use of the performance score, for showing what the style, the tendencies, the limits of variability and other characteristics are in any element of the best musical performance of to-day. There is a recognizable limit of tolerance within which the artist must be restrained. For example, when we take such a debatable and often unbearable feature as the vibrato of the singer, norms can be established to show that every good singer sings with a vibrato on practically every note intoned, whether he hears it or intends it or not. It is an inalienable element of goodness in voice. On an average, the twenty-five best recognized singers of to-day have a pitch pulsation of approximately a half-tone, which seems unbelievable because it is not heard as such. They have an average rate of pulsation of about six and one-half per second, which tends to take the form of a smooth sine curve and may be in pitch, intensity or timbre and frequently is in all three. Excellent but untutored primitive singers have approximately the same kind and degree of vibrato as do recognized musicians.

But these norms of prevailing excellence in voice can readily be refined. Norms of average performance for violin and other instruments have been established. If we assume, for example, as is generally conceded, that the violin vibrato is more musically acceptable than the prevailing voice vibrato, we can take the best violin vibrato as a model for the establishment of a more ideal norm and proceed in a short time to refine the vibrato of a singer to something like the violin norm, which is barely half as conspicuous as the prevailing vocal norms. Psychologists have shown how this can be done for any pupil or any artist now on the stage. It is difficult to imagine what a tremendous advance in the art of singing such a modulation of the prevailing vibrato among singers would be if such reformation of the stage were attempted seriously. It would ban the tremolo, which is simply a bad vibrato, and would contribute vastly to the beauty in flexibility, tenderness and richness of tone. It took psychologists to show what the vibrato is, how bad the prevailing vibrato may be and how it can be improved.

It furnishes instruments and techniques which will shorten the time of musical training and yield a higher precision and mastery than is ordinarily obtained.

Thanks to the extraordinary development in the recording and transmission of sound on principles involved in the radio, we are now in a position to equip the music studio, both public and private, with training instruments. Skill in pitch intonation is gained by training in front of an instrument which shows instantly, down to a hundredth of a whole-tone step, the precision, artistic deviation or degree of error in singing or playing in pitch. The pianist can practice various principles of artistic dynamics in phrasing by keeping his eye on a dial which registers all dynamic changes in terms of defined units of intensity of tone. The student who has difficulty with rhythm can go through rigorous exercises on model patterns and see how he conforms to these patterns either in terms of time as measured in hundredths of a second or of stress as measured in terms of decibels. The most difficult feature which both vocal and instrumental students have to master is that of tone quality. And here again one can have the advantage of an instrument which shows the wave form of his tone the instant it is sounded in such a way that he can compare it with the desired norm, and can thus practice with his visual aid to extraordinary advantage. In short, music is falling in line with industry and war in turning to mechanized features as instrumental aids; and it can be said conservatively that where this is done, we can predict an extraordinary shortening of the time of training for a specific skill and a hitherto unattainable degree of precision.

It enables us to record, preserve and interpret music in all forms of historical interest.

The musical anthropologist now faces unlimited facilities for accumulating a wealth of historical material in music. The phonograph recordings are now good, and the acoustic recordings with moving pictures now have sufficient fidelity for scientific purposes. Portable moving picture machines are now available in all parts of the world and the producers and news-gathering interests are glad to cooperate with scientists. The Hollywood producers have under consideration a plan for sending musical and linguistic anthropologists into primitive fields a year or two in advance of their proposed filming. Such an expert could thus make a preliminary scientific survey of the prevailing types of music and the performers which would be available for the filming industry and for purely scientific purposes. The industries will be repaid by the spirit of cooperation from the natives which can be cultivated. The field camera will be at the free disposal of the musical anthropologist for the recording of such scientific and artistic features as he may have found significant for the science of music. The sound tracks may be accompanied by significant moving pictures of dance and other forms of dramatic action which are essential to vitalize the music. In short, the problem of how to record primitive music is solved. The problem now before us is to find workers who can analyze and utilize that material for the history, science and art of music. The phonographic and film recording of the best music of to-day is of such high quality that any artist will be glad to be immortalized by the faithful preservation of his music through recordings. Here, again, we already have unlimited source material for scientific analysis, a gold mine for musicologists. One who was at work on the collection and preservation of music three or four decades ago is in a position to appreciate the fabulous advantages the collector of to-day has over the collector of twenty years ago.

It furnishes the groundwork for a future science and philosophy of musical esthetics.

Musical esthetics of the past has been largely a speculative armchair product. With the coming in of facilities for measurement of musical values which should constitute the groundwork of esthetics, we enter upon a radically new era in this field. Armchair theories can now be put to experiment to be verified and discarded, modified or simplified. This applies particularly to all aspects of the nature and significance of scales and every other aspect of intervals, to all studies of the evolution of musical feeling, to all aspects of the evolution of musical values, to the fundamental concepts of the power of music and to theories of goals to be attained. The study of such total problems can now be fractionated in the scientific attitude of dealing with one specific element at a time; such as some particular phase of harmony, balance, symmetry, resolution or musical license. For this purpose, a radical revision of terminology for the scientific and philosophical discussion of musical esthetics must be introduced.

The scientific procedure in a new and unlimited field of this kind is a slow and arduous process and in any generation, mere beginnings can be made. But, as in the introduction of scientific methods in the classification of plants and animals and the interpretation of their complete life histories, once the scientific attitude is made possible the purely speculative will gradually become less and less acceptable as a final solution. More progress toward a scientific approach to musical esthetics has been made in the last twenty years than in all preceding history.

Coda. There is, of course, a very large body of scientific principles and means of progress developed by musicians themselves in creative experimentation and thinking within the art. That is taken for granted. The features here discussed are drawn from contributions in current science which have a bearing on music. For the purpose of concrete illustrations, it is limited to features with which the author has had first-hand acquaintance; many other scientific approaches deserve mention. The aim has been to present a point of view and a comparatively new frame of reference for scientific thinking in music.

What is here indicated for music applies in principle to all the other fine arts, especially those of language, drama, poetry and dance. The more we rise into a consideration of the common elements of all artistic creative power and the assimilation of art in daily life and philosophical thought, the more we become aware of a common ground of interest, appreciation and cultivation of the scientific spirit in all arts, both pure and applied.

THE TASKS BEFORE US[1]

By Dr. WORTLEY F. RUDD

MEDICAL COLLEGE OF VIRGINIA, RICHMOND; PRESIDENT OF THE SOUTHERN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MAY I say in the beginning that this is going to be no after-dinner speech, except that we have just eaten a good meal. No stories will be told, and no attempt at humor. A deadly seriousness of purpose that is eating at my heart and at yours as, across the years, you and I have appraised the South as it is and then inventoried the region and made up from these findings a blue print of what the South can and should be, prompts me to speak briefly but very earnestly at this time.

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[1] Remarks of the president at the Atlanta meeting of the Southern Association of Science and Industry.

That others are deeply concerned with these same general problems about the South at the present time is indicated by the fact that for the Memphis meeting of the American Chemical Society, to be held later this month, there has been set up a symposium on "Chemistry in the South." I have the assignment "Chemistry in Virginia" in connection with that symposium. Naturally, these two assignments in the same field have urged me to a more than casual study of these problems.

At the inauguration of Dr. Oliver C. Carmichael as chancellor of Vanderbilt University in 1938, an excellent symposium on "Graduate and Research Programs in the South" had a conspicuous place in the exercises. In a paper by Dr. Charles W. Pipkin, dean of the Graduate School of Louisiana State University, presented on that occasion, we find an excellent study of this subject so vital to our region. A single phrase from Dr. Pipkin's paper may be quoted here as setting forth a sort of ideal toward which our hopes and dreams for the South may be directed as we work together. He says, "An empire awaits a philosophy generous enough to shape a great destiny." Although taken out of its context, the phrase epitomizes so admirably both the tasks before us and the possibilities of their ultimate accomplishment that I have felt impelled to quote it here.

Were I permitted to appear before some all-powerful tribunal and given the privilege to choose the things I most desire to have, or given the ability to accomplish the things I most desire to accomplish, certainly high up in the choices I would make would come the ability to arouse the people of our region—able but smug people, thousands upon thousands of them in these southern states—to a full realization of the potentialities—the almost unlimited potentialities—that lie all around us here in this favored region.

May I also be permitted to say that were another gentleman, who is with us to-night, given the same privilege of choice, I am constrained to believe he would give this choice first place also, and, if granted his request, his enthusiasm would be so overwhelming he would forget to make any further requests of any kind. You recognize, of course, that I refer to our secretary, Dr. George D. Palmer. Seldom have I ever known such boundless enthusiasm for a cause, and such tireless energy as Dr. Palmer puts into the task of getting started among us here in the South some workable methods for studying Southern problems intelligently, and then doing something about these same problems.

Despite an all-out war effort such as none of us dreamed could ever come to this country, and which is making it impractical for many scientific societies to hold their 1942 meetings at all, our organization is celebrating its first birthday here in the very heart of the South as guests of the Georgia Academy of Science. The movement which resulted in the formation of the Southern Association for the Advancement of Science was born of a long existing and profound conviction among many leading southerners that the time was ripe for a representative cross section of the people of the region—scientists, industrialists, business men and women—to pool their knowledge and interests and talents in a common effort to do certain things for the South which must be done by some group before it, as a region, can even reasonably well take the place in the nation which, by location, climate, natural resources and native intelligence, it is richly entitled to take.

Naturally, I am aware that this sounds somewhat fantastic, or at least too idealistic. Maybe it is; time alone will determine this. However, that the movement gained sufficient momentum to bring to bear upon the problems involved at least the wishful thinking of such a representative group as we now have, is much more—I am inclined to think—than a promising gesture.

An unfortunate habit that I early developed may be illustrated as follows: In bird hunting, all too frequently, I could not resist the temptation to shoot at the covey; therefore, few bird suppers. My hunting companion always picked his bird deliberately—one or two on the rise—and usually he got them. Although I killed few birds, I did gradually learn the fallacy of this method of hunting. As I have grown older, to steer clear of "covey shooting" has become almost an obsession with me. As you know, what the Southern Association for the Advancement of Science is trying to do is to pick from the covey of problems that sorely afflict the South one or two at a time and, over the years, to study those selected with as fine persistency and efficiency, and open-mindedness, and intelligence, as there is in our region.

It would seem hardly necessary for your president to present at this time to the group already in a general way committed to the above policy, the objectives of this organization. However, as a matter of record, and also with the hope that we make every possible effort to follow this general method of attack—or some better one through the years—it may not be unwise to name a few problems any one of which probably merits all the effort we can put into it even for a decade or two.

As president of the Virginia Academy of Science a year ago, I was confronted with a similar dilemma. What could the academy do for our state? Did a group of some 800 or 900 men and women, the very cream of scientifically minded folk in Virginia including a fair number from industry and business, have any right to meet from year to year with no objective other than the reading of papers on past accomplishments and the transaction of business necessary for the well-being of the organization? Having no answer of my own, I addressed this inquiry to every academy member. Also, leading scientists throughout the country were asked the same question. The replies—and an unusually large number came in—indicated that overwhelmingly men and women believed that the academy should undertake problems of state-wide interest in which many individuals, representing all groups in the academy, might have a part. Their suggestions of practical projects opened our eyes to possibilities of such a program, if properly prosecuted. Under the guidance of what we called a long range planning committee, although less than a year has passed, one project of major interest has already been completely set up and fine progress is being made on it. The General Assembly of Virginia has just appropriated $5,000 for the publication of the first report of this work. This has been given in some detail simply to indicate how far-reaching projects may become if undertaken as a sort of composite of ideas and talents and enthusiasm and efficient leadership, intelligently directed toward specific, practical objectives.

In the light of this experience in academy work we have, during the past year, sent similar requests to a great many leaders throughout the South. Many practical suggestions about what we should do have come in as a result of this inquiry. To name just a few of these: Closer cooperation between science and industry; new and better uses for our raw materials; conservation of our forest resources; after cotton, what? The post-war South; vocational education for the South; more and better fundamental research; cooperative research; control of industry in the South by the South; decreasing the handicaps of southern industry; and literally dozens of others equally as important and applicable to our problems. The panels that are being held at this meeting illustrate well how already some of these projects are being studied.

To avoid wasting our energy in our attempts to decide upon which individual problem to place the emphasis in the beginning, may I suggest that perhaps one of the first and most important tasks of our organization is authorization of the appointment by the incoming president and secretary, acting jointly, of a committee of probably one member from each southern state whose chief duty it shall be to lay out for the years ahead a few distinctive problems which lie well within our field of endeavor. The tenure of such committee members should be reasonably long, as much time will be required for it to set up in workable form projects of major importance to the region, and then see that they are followed through. In the hands of a carefully selected group of this kind, the possibilities of our organization for effective and intelligent service for the South are limited only by the willingness of our men and women to work everlastingly at tasks that challenge the best that there is in them.

What we most need, it seems to me, is a great resurgence of social, economic, political, cultural, industrial and educational leadership in our region. Across the years, perhaps the lusty infant born at Mobile a year ago will really grow up to occupy a commanding position in bringing about fundamental changes in our way of thinking and working and living, to the end that southern science, and southern business and the southern press and southern capital and southern brains and southern raw materials and southern culture and southern research may all be so effectively meshed that our sons and daughters may stay in the South and be adequately trained for all the demands that the development of our natural resources may make upon them. That the capital required to finance a growing industry shall be southern capital; that our research—pure, industrial, economic and social—shall be done at home, and much more largely by our own southern boys and girls.

For a mere pedagogue to present such a roseate picture of what the South may become under wise and patient and persistent planning and leadership is characteristic, perhaps, of our lack of practical experience in outside affairs. Frankly, however, I would have little faith in the ability of this organization to make any considerable contribution toward the sensible working out of the things we must do, were it not that before we organized at all it was wholeheartedly agreed among us that business men, industrialists and capitalists from all over the South should have a large share in planning and directing its policies. How much in earnest such men are in these plans is evidenced by the fact that in Alabama—the birthplace of the Southern Association for the Advancement of Science—there has already been set up by the State Chamber of Commerce, as a sort of outgrowth of this organization, the Alabama Research Institute. The importance of this as a prophecy of what may and should come in other states to give these practical-minded men opportunity to have their research problems of all kinds finally worked out at home, can hardly be estimated.

It has been said, and correctly we believe, that the number of patents awarded in any state or region is at least one measure of the progress that is being made. Such a standard of measurement applied to the South now will indicate clearly how desperately we need research—pure research, which underlies all other types; industrial research, economic research, and relatively how little of these is being done among us.

Another evidence of the business man's interest is seen in the program that has been set up for this meeting. Please note the number of influential and successful non-pedagogues that are having a share in it. Personally, my own interest in the project would be greatly curtailed if this were not the case.

It is my profound hope that more and more of both groups—business men and professional men—will look to the Southern Association for the Advancement of Science to help in their problems, and more and more will the organization be able to help in their solution.

Finally, it is my considered judgment that if we do no "covey shooting" at southern problems, but rather pick them singly and do a good job in getting our composite aim right down the barrel at them, our outlook for service to the region is genuinely heartening.

Quoting Dr. Pipkin again: "An empire awaits the philosophy generous enough to shape a great destiny."

OBITUARY

HERBERT FOX

Herbert Fox, son of Samuel Tucker Fox and Hannah Freas Fox, was born in Atlantic City on June 3, 1880. He received his A.B. from Central High School, Philadelphia, in 1897, his M.D. from the University of Pennsylvania in 1901. He served his interneship in the Philadelphia General Hospital and in the Presbyterian Hospital, Philadelphia. In 1903–04 he was a member of the Philadelphia Typhoid Commission; in 1904, pathologist to the Rush Hospital, Philadelphia; in 1905–06, second assistant in pathology under Heinrich Albrecht in Vienna.

In 1906 he became pathologist in comparative pathology for the Philadelphia Zoological Society, a position he held until his death. He at once took a leading part in the scientific studies emanating from the collection in their Zoological Gardens. He studied particularly the incidence and control of tuberculosis among the primates and in his last decade the pathology of arteriosclerosis in mammals and birds and of chronic arthritis. His large monograph on "Disease in Captive Wild Mammals and Birds" (1923) is based on the record of 6,000 autopsies performed under his supervision. It is a thorough and exhaustive treatise widely used as a reference work. Under his direction the Zoological Society's Penrose Research Laboratory, the pioneer institution of its kind, rose to its position of leadership. He became professor of comparative pathology, University of Pennsylvania, in 1927.

From 1906 to 1911 he was officer in charge of the laboratory of the Pennsylvania Department of Health.

In 1911 he succeeded Alfred Stengel as director of the William Pepper Laboratory of Clinical Medicine, University of Pennsylvania, which position also he held until his death. Here he guided the development of the laboratory facilities in the university's major teaching hospital through the period of rapid advance of the clinical laboratory. His own contributions were especially in relation to diseases of the lymphatic tissues.

He was co-author with Alfred Stengel of four editions of their "Textbook of Pathology."

In 1915 he was a member of the commission managing the outbreak of poliomyelitis at Erie, Pa. From 1915 to 1926 he was pathologist to the Children's Hospital, Philadelphia. In the World War he served from 1917 to 1919 as major, in charge of the cantonment laboratory at Camp Zachary Taylor, Louisville, Ky.

He was a fellow of the College of Physicians of Philadelphia and of the American Association for the Advancement of Science and a member of the American Philosophical Society, the Association of Pathologists and Bacteriologists, the American Society of Clinical Pathologists, the American Medical Association and the Academy of Natural Sciences of Philadelphia, as well as of several honorary fraternities.

He died on February 27, 1942, after several months of illness.

In 1904 he married Louise Carr Gaskell, who died in 1933. Of their three children, two survive, Margaret Fox Hentz and Samuel Tucker Fox, 3rd. In 1938 he married Mary Harlan Rhoads, who survives him.

In his work he was meticulous to secure perfection in the smallest details. An omnivorous reader, he was a connoisseur of many of the arts and a welcome companion at any gathering. His happiest hours were probably those in which he lightly dropped an almost invisible fly on the ripples of the streams in Pennsylvania or Nova Scotia.

J. Harold Austin

RECENT DEATHS AND MEMORIALS

The death at the age of sixty years is announced of Charles Francis Harding, professor of electrical engineering and director of the electrical laboratory at Purdue University.

Dr. Carl Oscar Johns, chemical consultant, director of research, retired, of the Standard Oil Development Company, died on April 18, at the age of seventy-one years.

Dr. Shirley W. Wynne, from 1928 to 1933 health commissioner of New York City, died on April 19, at the age of fifty-nine years.

Dr. John Baldwin Walker, until his retirement in 1938 professor of clinical surgery at the College of Physicians and Surgeons, Columbia University, died on April 13, at the age of eighty-two years.

Dr. Maria M. Roberts died on April 12, at the age of seventy-four years. Among the offices held during her fifty years of service at the Iowa State College were the positions of dean of the Junior College and professor and head of the department of mathematics.

Professor Jean Perrin, Nobel laureate in 1926, formerly president of the French Academy of Sciences, died on April 17 at the age of seventy-one years. Since Dr. Perrin came to the United States last December he has been dean of the faculty of sciences of the recently established Franco-Belgian Free School of Higher Studies.

It is planned to establish a library in the University Hospital, in Philadelphia, in honor of the late Dr. George E. de Schweinitz, professor emeritus of ophthalmology of the University of Pennsylvania School of Medicine. Friends of Dr. de Schweinitz have undertaken to finance the project.

SCIENTIFIC EVENTS

THE WILLIAM LOWELL PUTNAM MATHEMATICAL COMPETITION

Professor W. D. Cairns, secretary-treasurer of the Mathematical Association of America, reports that the department of mathematics of the University of Toronto, Canada, won the first prize of $400 in the fifth annual William Lowell Putnam Mathematical Competition held on March 7. This is the third year in five that the University of Toronto has taken first place in the competition made possible by the trustees of the William Lowell Putnam Intercollegiate Memorial Fund, left by Mrs. Putnam in memory of her husband, a member of the Harvard class of 1882, and sponsored by the Mathematical Association of America. The members of the Toronto team were K. S. Hoyle, H. V. Lyons, M. A. Preston.

The second prize of $300 is awarded to the department of mathematics of Yale University, the members of whose team were F. H. Brownell, 3rd, A. M. Gleason, A. E. Roberts, Jr.

The third prize of $200 is awarded to the department of mathematics of the Massachusetts Institute of Technology, with a team composed of E. D. Calabi, W. S. Loud, G. P. Wachtell.

The fourth prize of $100 is awarded to the department of mathematics of the College of the City of New York, the members of whose team were Herman Chernoff, Harvey Cohn, Edward Gordon.

In addition to these prizes to the departments of mathematics with winning teams, a prize of $50 each is awarded to the following five persons given in alphabetical order whose scores ranked highest in the six-hour examination: Harvey Cohn, College of the City of New York; A. M. Gleason, Yale University; W. S. Loud, Massachusetts Institute of Technology; H. V. Lyons, University of Toronto; M. A. Preston, University of Toronto. One of these five will later be chosen to receive a $1,000 a year scholarship at Harvard University.

The members of the four winning teams will receive individual cash awards according to the ranks of their teams, and all individuals receiving awards will also receive medals.

Honorable mention has been awarded this year to four teams and to five individuals. The teams are from the department of mathematics, Cooper Union Institute of Technology, New York, members of the team being Harold Grad, M. S. Klamkin, Kenneth Robinson; the department of mathematics, Harvard University, Cambridge, members of the team being R. M. Bloch, L. S. Shapley, J. A. Zilber; the department of mathematics, New York University, New York, members of the team being Melvin Lax, Harold Lewis, Henry Shenker; and the department of mathematics, Swarthmore College, Swarthmore, members of the team being N. B. Hannay, W. H. Mills, M. S. Raff. The five individuals receiving honorable mention are E. D. Calabi, Massachusetts Institute of Technology; C. P. Gadsden, Tulane University; K. S. Hoyle, University of Toronto; Melvin Lax, New York University; W. H. Mills, Swarthmore College.

THE INTER-AMERICAN TREATY ON NATURE PROTECTION

The National Parks Association reports that seven countries have ratified the Inter-American Treaty on Nature Protection and Wildlife Preservation to date, three of them since the United States entered World War II on December 8, 1941. This is welcome evidence of the intention to continue permanent cooperation among the nations of the Western Hemisphere for the peaceful purposes of preserving unique natural features, historic objects and vanishing wildlife.

Haiti became the fifth country to deposit its ratification with the Pan American Union on January 31, 1942. In accordance with the provision of the original convention between the American republics, that it "shall come into force three months after deposit of not less than five ratifications with the Pan American Union," the treaty will take effect in the ratifying countries on May 1 of this year.

In order of deposit, the seven ratifying countries are as follows: the United States of America, April 7, 1941; Guatemala, August 14, 1941; Venezuela, November 3, 1941; El Salvador, December 2, 1941; Haiti, January 31, 1942; the Dominican Republic, March 3, 1942, and Peru (not yet deposited).

The original convention has been signed by the representatives of eleven other Latin-American countries, leaving only three that have taken no action to date. Species of fauna and flora to be specially protected under the treaty have already been designated by addition to the convention for Argentina, Bolivia, Brazil, the Dominican Republic, Ecuador, El Salvador, Guatemala, Mexico, Nicaragua and the United States.

The first official step towards realization of a Pan-American program for nature protection was taken with the signing of the original convention in Washington, D. C., on October 12, 1940. Now that the second step is assured with the coming into force of the treaty on May 1, it remains for each ratifying country to fulfil its obligations by enacting enabling legislation and issuing executive orders or decrees to implement the treaty and effectuate its purposes. Continual efforts to foster public education in the field of conservation will be necessary to give these official policies practical application and significance throughout the New World.

The objects of the treaty are to protect and preserve native fauna and flora in the American republics, including migratory birds, and to protect and preserve scenery of extraordinary beauty, unusual and striking geologic formations, regions and natural objects of esthetic, historic or scientific value. It provides for the establishment of national parks, national reserves, nature monuments and strict wilderness reserves as soon as possible after its effective date.

GRANTS OF THE NUTRITION FOUNDATION

The Nutrition Foundation, Inc., recently organized with the support of the food industry, will make its first series of grants, to promote research and education in the science of nutrition, effective on July 1. An announcement made by George A. Sloan, president of the foundation, reads in part:

> Grants made by the foundation will go to established institutions in the United States and Canada. The first series of grants, effective July 1, will be made following action to be taken by the trustees at their May meeting. Problems of critical importance in the war emergency will be given primary consideration. Food supplies for our allies and for specialized divisions of our armed forces as they spread to the far corners of the earth can not be provided without careful planning and adequate precautions.
>
> Grants will also be made in the support of projects that have a direct bearing upon public health. There is obvious need for more information concerning the relation of diets to dental caries, and much remains to be discovered regarding the nutritional requirements of infants, growing children and people in old age. The foundation's long-time program, however, will place greatest emphasis upon fundamental research to advance the frontiers of science.

A CHINESE SCIENTIFIC SOCIETY ON WEST COAST

Through the efforts of a number of Chinese scientists and technical students in Southern California a new scientific society has been organized, to be called the "Chinese Natural Science Association, U. S. West Coast Chapter," under the auspices of the Chinese Natural Science Association at Chungking, China. The aim of this new organization is the advancement of study and research in the natural sciences and the attainment of a closer cooperation among the scientific workers of China and the United States.

The chapter now has two sections: one in Northern California centered at Berkeley and one in Southern California.

The first meeting was held on March 8. Professor Carl D. Anderson, of the California Institute of Technology, spoke on "Cosmic Rays and the Elementary Particles of Matter," and Dr. Hsueh Chung Kao spoke on "Vitamins in Nutrition." The second meeting will be held on April 12. Dr. John A. Anderson will speak on "The 200-inch Telescope" and Dr. Tze-Tuan Chen, lecturer in zoology, University of California at Los Angeles, will speak on "Some Recent Advances in Protozoology."

THE AMERICAN SOCIETY OF MAMMALOGISTS

The twenty-fourth annual meeting of the American Society of Mammalogists was held at the American Museum of Natural History, New York City, from March 31 to April 4.

Officers of the society elected for the ensuing year are as follows: ***President,*** A. Brazier Howell, department of anatomy, the Johns Hopkins Medical School; ***Vice-presidents,*** E. Raymond Hall, University of California at Berkeley, and Edward A. Goldman, U. S. Fish and Wildlife Service, Washington, D. C.; ***Recording Secretary,*** Seth B. Benson, University of California at Berkeley; ***Corresponding Secretary,*** Emmet T. Hooper, University of Michigan, Ann Arbor; ***Treasurer,*** Viola S. Schantz, U. S. Fish and Wildlife Service, Washington, D. C.; ***Editor,*** William B. Davis, Texas Agricultural and Mechanical College, College Station. *Directors*, elected for the period 1942–44, are: William H. Burt, University of Michigan; J. Kenneth Doutt, Carnegie Museum, Pittsburgh; Claude W. Hibbard, University of Kansas; Olaus J. Murie, U. S. Fish and Wildlife Service, Jackson, Wyo.; and W. E. Saunders, London, Ontario. *Additional directors* are Victor H. Cahalane, National Park Service; William J. Hamilton, Jr., Cornell University; J. Eric Hill, American Museum of Natural History; Remington Kellogg, U. S. National Museum, and Otis Wade, State University of Nebraska.

Since in times of stress, such as the present, there is danger that public resources of permanent value may be exploited unduly to furnish food and other materials, the society passed a resolution opposing the use of any such materials from National Parks, National Monuments or National and State Wildlife Refuges, unless it be demonstrated that such materials can not be obtained elsewhere. It was also resolved that as investigations are now in progress to determine whether or not it will be necessary to exterminate the deer of the Seminole Indians Reservation in order to eradicate tick fever in cattle, to oppose destruction of the deer until the investigations are completed and the results are made public for consideration by the authorities concerned and with due regard to the rights of the Indians.

THE AMERICAN ASSOCIATION OF PATHOLOGISTS AND BACTERIOLOGISTS

AT the annual meeting of the American Association of Pathologists and Bacteriologists, which opened at St. Louis on April 2, the following officers were elected for the coming year: Dr. Paul R. Cannon, *President;* Dr. Wiley D. Forbus, *Vice-president;* Dr. Howard T. Karsner, *Secretary;* Dr. Alan R. Moritz, *Treasurer;* Dr. Shields Warren, *Incoming Member of Council;* Dr. Francis Bayless, *Assistant Secretary;* and Dr. Granville A. Bennett, *Assistant Treasurer.*

Dr. Esmond R. Long, director of the Henry Phipps Institute of the University of Pennsylvania, was elected the representative of the association in the Division of Medical Sciences of the National Research Council, and Dr. Jacob Furth, of the department of pathology of the Cornell University Medical College, was appointed a member of the Advisory Committee of the Lymphatic Tumor Registry of the association.

The Gold Headed Cane of the association was awarded to Dr. James Ewing, professor of oncology at the Cornell University Medical School, formerly director of Memorial Hospital.

The next annual meeting of the association will be held in Chicago on April 1 and 2, 1943. At this meeting a symposium is planned on Infectious Granulomas, exclusive of tuberculosis and syphilis. Dr. Wiley D. Forbus has been elected referee.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will begin its annual meeting at Washington, D. C., under the presidency of Dr. Frank B. Jewett, at the usual time on the 27th of the month, the fourth Monday in April. The meeting this year, however, will be limited to two days, and there will be no presentation of scientific papers or social functions, except a smoker for members on Monday evening. Apart from the annual election of members the time will be devoted to a discussion of the present work of the academy, with special reference to the provisions of its charter which makes it the scientific adviser of the government. The National Research Council, a committee of the academy, which was organized in the emergency of the last war by President Wilson, is now active in the study of scientific problems connected with war work.

THE American Philosophical Society, under the presidency of Roland S. Morris, is meeting on Thursday, Friday and Saturday of the present week in the hall of the society, on Independence Square, Philadelphia. The sessions on Thursday were devoted to an archeological program, the Franklin Medal Lecture being given in the evening by Dr. Sylvanus G. Morley, of the Carnegie Institution of Washington. The Penrose Memorial Lecture is given on Friday evening by Dr. James R. Angell.

DR. MARSTON T. BOGERT, emeritus professor of organic chemistry at Columbia University, has been elected to honorary membership in the Society of Chemical Industry of England, an organization of which he is the senior past-president. Upon the completion of his presidential term in 1913, he was succeeded by Sir William Crookes.

Nature reports that S. Bairstow, of the Chemical Research Station, Research Department of the London Midland and Scottish Railway, has been awarded the Herbert Jackson Prize for 1941, for a paper entitled "The Relation between Calorific Value and the Road Performance of Producer-Gas Vehicles."

THE William Julius Mickle Fellowship of the University of London has been awarded to Professor Alexander Fleming, professor of bacteriology in St. Mary's Hospital Medical School.

THE Academy of Medicine of Washington, D. C., held a dinner meeting on April 22 to hear an address entitled "War's Contribution to Medicine, and Medicine's to War" by Professor Henry E. Sigerist, director of the Institute of the History of Medicine at the Johns Hopkins University. Officers of the academy recently elected are: *President,* Joseph F. Siler; *Vice-president,* Ralph E. Gibson; *Treasurer,* Roger M. Choisser; *Secretary,* (re-elected), Errett C. Albritton; *Board of Directors,* Matthew Perry, Roscoe R. Spencer, Lyman J. Briggs, Prentiss Willson and Charles Thom.

AT the Nashville meeting of the Southern Society for Philosophy and Psychology the following officers were elected: *President,* Dr. Christian Paul Heinlein, Florida State College for Women; *Secretary-Treasurer,* Dr. Wayne Dennis, Louisiana State University; *Members of the Council,* Dr. Elizabeth Duffy, Woman's College of the University of North Carolina, Dr. S. Rains Wallace, Tulane University, and Dr. Peter A. Carmichael, Louisiana State University. The meeting next year will be held in Chattanooga.

DR. LAURENCE H. SNYDER, professor of zoology at the Ohio State University, will become chairman of the department of zoology and entomology on July 1, succeeding Dr. Raymond C. Osburn, who is retiring with the title emeritus. He has been chairman since 1917. During eighteen years of this period, 1918 to 1936, Dr. Osburn was director of the Franz Theodore Stone Laboratory on Gibraltar Island in Lake Erie.

Chemical and Engineering News states that William B. Fulton, senior surgeon in the U. S. Public Health Service Reserve, a former director of the Bureau of Industrial Hygiene of the Pennsylvania Department of Health, has been appointed chief of the Health Division, U. S. Bureau of Mines. He will direct the safeguarding of the physical welfare of workers in the mineral industries.

DR. THOMAS B. MCKNEELY, passed assistant surgeon in the U. S. Public Health Service, has been assigned to the Medical Division, Office of Civilian Defense, to assist in the organization of emergency medical services throughout the United States.

ACCORDING to the *Journal* of the American Medical Association, Dr. Julius Hass, who formerly occupied the chair of orthopedic surgery at the University of Vienna, has been appointed attending orthopedic surgeon, in charge of the Orthopedic Service, at Montefiore Hospital, New York City.

DR. RUTH HARTLEY WEAVER, registrar of vital statistics of Philadelphia, has been appointed director of health to succeed the late Dr. Martha Tracy. Dr. Weaver has served as epidemiologist of the city department of health and is at present assistant professor of epidemiology and vital statistics in the Temple University School of Medicine.

DR. ELSA ORENT-KEILES, formerly of the department of biochemistry of the School of Hygiene and Public Health of the Johns Hopkins University, is now in charge of the Nutrition Research Laboratories and assistant chief of the Foods and Nutrition Division of the Bureau of Home Economics, U. S. Department of Agriculture, Beltsville Research Center, Maryland.

DR. RALPH G. MEADER, assistant professor of anatomy at the Yale University School of Medicine, has been appointed assistant to the director of the Jane Coffin Childs Memorial Fund for Medical Research. He will act as supervisor during the absence of Lieutenant Colonel Stanhope Bayne-Jones, director, who has reported for duty in the Office of the Surgeon General, Washington, D. C.

DR. CARL J. KLEMME, professor of pharmaceutical chemistry at the University of Minnesota, has become administrator of the experimental research laboratories of Burroughs, Wellcome and Co., Inc., Tuckahoe, N. Y.

THE Hercules Powder Company has established a fellowship for the year 1942, to be known as the Pine Chemicals Fellowship, at Mellon Institute of Industrial Research, University of Pittsburgh. Dr. George B. Feild of the institute will be the fellow.

DR. OLIN SEWALL PETTINGILL, JR., of the department of zoology of Carleton College, has been appointed editor of the Aves section of *Biological Abstracts.* He will handle the non-economic papers. Dr. W. L. McAtee will remain as associate editor to continue his work on the economic aspects of birds. Dr. Peter Gray, of the University of Pittsburgh, has been appointed editor of a new section, Apparatus and Technique, which will appear in an early issue. Dr. C. E. Blye, Division of Veterinary Medicine, University Farm, University of Minnesota, has become editor of the section of veterinary bacteriology and pathology; he takes the place of Dr. A. F. Sellers, who has been called to military service.

ON the evening of April 10, Professor Marston T. Bogert, of Columbia University, addressed the New York Section of the American Chemical Society and their friends at the Hotel Pennsylvania on the subject, "The Ramparts the Chemist is Guarding," in the course of which he discussed malaria and the serious quinine situation now confronting the world as the result of the occupation of Java by the Japanese.

AT a joint meeting on April 16 of the Washington Academy of Sciences and the Philosophical Society of Washington, Dr. Paul R. Heyl, chief of the Section on Sound of the National Bureau of Standards, delivered an address entitled "Cosmic Emotion."

The American Astronomical Society will meet at the Yale University Observatory on June 12, 13 and 14.

Under the joint sponsorship of the department of physics of the University of Pennsylvania and of the Philadelphia District Committee of the American Society for Testing Materials, there will be held on Friday and Saturday, May 15 and 16, at the University of Pennsylvania, a symposium on the physics of pigments and glasses. Leading technical authorities will prepare papers, and invitations are being extended to physicists, engineers and scientific men concerned with the problems to be covered. Dr. Frederick Seitz, of the university, is chairman of the joint committee in charge of the meeting.

A joint meeting of the American Association for the Advancement of Science, Section C, and the American Society for X-Ray and Electron Diffraction will be held at Gibson Island, Md., from July 27 to 31. Registration and reservations are made through the director of the Gibson Island Conferences, Professor Neil E. Gordon, Central College, Fayette, Mo. A business meeting of the American Society for X-Ray and Electron Diffraction will be held at the Conference Room, on the afternoon of July 29.

Nature writes: "In 1939 the Australian Anthropological Association was formed after discussion between the Anthropological Associations of New South Wales, Victoria and South Australia at the meeting of the Australian and New Zealand Association for the Advancement of Science held in Canberra that year. The headquarters of the new association are to be situated in rotation for a period of two years in each State of the Commonwealth in which there is an anthropological society affiliated with the association. During the first two years of its existence the headquarters of the association were in Adelaide. Now they are at Sydney and will remain there until October 1, 1943, when they will be transferred to Melbourne. The official organ of the association is *Mankind,* which is the official journal of the Anthropological Society of South Australia. Officers of the association are as follows: *President,* Professor A. P. Elkin; *Vice-president,* F. L. S. Bell; *Hon. Secretary-Treasurer,* G. W. Watkins ("Hansard" Staff, Parliamentary House, Sydney)."

The name of the Laboratory of Vertebrate Genetics of the University of Michigan has been changed by act of the Board of Regents to the Laboratory of Vertebrate Biology. The change in name was made in order to indicate more adequately the scope of the laboratory, which for a number of years has included studies in ecology and in speciation as well as in genetics.

A handbook of physical constants, edited by Francis Birch, containing 325 pages, has been published by the Geological Society of America. It contains twenty-one sections prepared by nineteen specialists cooperating through the divisions of chemistry, physics and geology of the National Research Council. Copies may be consulted in geological libraries and can be purchased from the Geological Society of America, 419 West 117th Street, New York. N. Y.

The department of public health at the Massachusetts Institute of Technology is offering an accelerated program of public health training beginning on June 8 and allowing for the completion of a master's degree by February 6. These training programs are organized for public health engineers, health educators and workers in public health laboratories, as well as for administrators. Special summer courses are also being offered.

At Yale University faculty members are cooperating in the field of physical chemistry on a project of significance to the war effort. The investigation is being made at the university under the auspices of the U. S. Office of Scientific Research and Development. It is under the direction of Dr. Herbert S. Harned, professor of chemistry, assisted by: Ralph G. VanName, research associate; Benton B. Owen, associate professor; John E. Vance, associate professor; George M. Murphy, assistant professor; Henry C. Thomas, assistant professor; Julian M. Sturtevant, assistant professor; Scott E. Wood, instructor; Harold G. Cassidy, instructor; and James English, Jr., instructor.

The engineering education of women for service in Connecticut war industries will be undertaken this spring by the Engineering, Science and Management Defense Training Program of Yale University. The courses will be given in cooperation with the New Haven Y. M. C. A. Junior College and the Bridgeport Engineering Institute. During the next eight months Connecticut must train and employ 60,000 women in war industries, according to Professor Hughes, the representative of Yale University. The immediate need is said to be for 11,000 women. Of this number, a portion will receive training on the engineering level.

Appropriations amounting to nearly two million dollars for research to further the war effort have been made by the Government of the United States to the University of California. According to a statement made by Dr. Robert G. Sproul, president of the university, the larger part of the money will be expended on two projects—the cyclotron, under the direction of Professor E. O. Lawrence, at Berkeley, and the sound laboratory at San Diego, under the direction of Professor Vern O. Knudsen, dean of the graduate division at Los Angeles. It is stated that research projects from other places are being carried out at the University of California. The work, however, is of a confidential nature and information regarding it is forbidden.

DISCUSSION

CARBONATE-APATITE AND HYDROXYL-APATITE IN URINARY CALCULI

CALCIUM phosphate often has been reported as a constituent of urinary calculi, but the specific phase or phases present have long remained unidentified. Recently, however, Jensen[1] has found that a substance designated by him as colloidal apatite occurs in many phosphatic calculi. We have examined a small collection of kidney and bladder calculi by x-ray diffraction and optical methods and have found 31 individual stones to be composed in part or entirety of carbonate-apatite (dahllite). Hydroxyl-apatite was identified in one stone, and its presence in small amounts was suspected in two other stones. No other calcium phosphates were found, but Jensen has reported brushite ($CaHPO_4 \cdot 2H_2O$) and whitlockite ($Ca_3(PO_4)_2$) in single instances. Carbonate-apatite, together with calcite, aragonite and vaterite B (μ-$CaCO_3$), has also been recognized by Phemister, Aronsohn and Pepensky[2] among the inorganic constituents of cholesterol gallstones.

Stones composed wholly of carbonate-apatite are relatively rare. Whewellite ($Ca_2O_4 \cdot H_2O$), weddellite ($CaC_2O_4 \cdot 2H_2O$) and especially struvite ($NH_4MgPO_4 \cdot 6H_2O$) are ordinarily present in greater or less proportion. Carbonate-apatite was not found in the five uric acid stones available for examination. Sufficient data are not yet at hand to warrant any conclusions as to the clinical significance of carbonate- and hydroxyl-apatite in urinary deposits.

The substances appear under the petrographic microscope as irregular grains with a banded or spherulitic structure. The material usually is colorless, pale yellow or brown. In some instances the color is deep reddish brown or an intense greenish yellow. The substances are sensibly isotropic, and the index of refraction varies widely both in different stones and in the same stone. The observed extremes in index are 1.520 and 1.605, but the usual range is 1.555–1.590 and the average value of all our measurements is about 1.575. The range in index between different layers in a single calculus is, on the whole, about 0.025, but may extend to as much as 0.04. The isotropic character is due to aggregate polarization in a mass composed of submicroscopic crystallites. The variation in index doubtless is due to variation in the content of adsorbed and capillary water. The material is not amorphous, as has been stated, and affords a distinct, although rather diffuse, x-ray powder pattern of the apatite type. It is interesting to note that the isotropic carbonate-fluor-apatite which forms the major constituent of fossil bone and teeth has in general a much higher range of indices. Rogers[3] found half of 250 measurements to lie between 1.600 and 1.610, with an overall range of 1.573 to 1.621. This difference must be due to the relatively large water content of the urinary deposits, since the macrocrystalline fluorine-containing apatites have in general lower indices than apatite members containing only hydroxyl.

A bladder stone composed of carbonate-apatite admixed with about 0.2 per cent. struvite was examined in some detail. The stone weighed 65 grams. A quantitative chemical analysis gave CO_2 5.50, Cl none, F none, H_2O lost at 110° 4.86, H_2O lost at 1000° 4.97 (total H_2O 9.83). The index of refraction largely ranged between 1.575 and 1.590. About three fourths of the total water content was lost by heating at 305° and the index increased to values in the range 1.595–1.605. The rest of the water was expelled by heating at 1000° C and the index increased to values between 1.635 and 1.655 with most grains about 1.643; this material was quite isotropic but gave a very sharply defined apatite-like x-ray pattern.

Hydroxyl-apatite can be distinguished from carbonate-apatite by the lack of effervescence in weak HCl. The test is conveniently made on crushed grains on a glass slide under moderate magnification. The indices of refraction are not diagnostic, as the slight differences in indices existing in macrocrystalline, birefringent samples are obscured by the large and variable content of non-essential water in the substances as they appear in isotropic urinary deposits. It should be emphasized that an isomorphous series in point of carbon content exists between the two compounds. The general formula may be written $Ca_6(OH)_2(P,C)_6O_{24}(Ca,C)_4$.

CLIFFORD FRONDEL
HARVARD UNIVERSITY

EDWIN L. PRIEN
POSTON, MASS.

THE SACRAL SPOT IN BENGAL

IN the summer of 1941, while engaged upon a serological study of a pair of fraternal Sindi twins in Calcutta, a faint discoloration was noticed on the sacral area of both the male and the female at the age of three months. This was suspected of being a so-called "Mongoloid spot," already fading out.

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[1] A. T. Jensen, *Acta Chirurgica Scandinavica*, 84: 207, 1940.

[2] D. B. Phemister, H. G. Aronsohn and R. Pepensky, *Annals of Surgery*, 109: 161, 1939.

[3] A. F. Rogers, *Bull. Geol. Soc. Amer.*, 35: 535, 1924.

There were only a few days available before I had to leave and I was able to examine fifty new-born Bengali babies at the Lady Dufferin Victoria Hospital in Calcutta, as well as eight infants from other provinces. In this small sample of bluish-grey irregular pigmented patch on the sacro-coccygeal and gluteal regions was observed in 38 and absent in 12 of the 50 Bengalis. The pigmented spot varied from a small patch 1 to 3 inches in diameter over the sacrum, or to one side, to a large irregular discoloration over the whole area, or one patch over the sacrum and another over one or both buttocks. These children belonged chiefly to Bengali Brahmin, Kayastha and Muslim communities; a few were classified by caste as shown in Table I.

TABLE I

SACRAL SPOT IN 16 BENGALI BABIES BY CASTE

Caste	No.	Spot present	Spot absent
Bania	2	2	0
Brahmin*	4	4	0
Goldsmith	1	1	0
Kayastha*	4	2	2
Tatti (weaver)	2	0	2
Vaidya*	1	1	0
Muslim	2	2	0

* High-caste Hindus.

The spot was familiar to the Indian nurses, and it is called "jot" (spot) in Bengali. One nurse from the Himalayan region said, "We call it the sign of a Hill baby," the Hill people being, of course, the Mongoloid Nepalese and Tibetans.

In answer to my inquiry Mr. S. S. Sarkar, of the Bose Institute, wrote, "Mongolian spots are quite common in Bengali children. They can be observed up to a certain time after birth when the skin is a bit lighter, but with age the skin gets darker and the spots can not be distinguished. Instances of its persistence up to a fairly adult age are, however, known. . . . I have seen it in German babies in Berlin."

On the way home I was able to visit the maternity ward of the General Hospital of Batavia, Java. The doctor in charge kindly allowed me to examine all the newborn babies. He said that the Mongoloid spot was such a universal feature of the natives that it is taken for granted. He also reported that it is absent in the Dutch infants and also in the Indonesian × Dutch hybrids. There were well-marked spots, similar to those observed in Calcutta, in 15 Javanese babies examined and no spot on the one Dutch and one Eurasian baby present. The Javanese belong to the Malayan branch of the Mongoloid race.

Even though the sacral spot may be a recessive character, it evidently segregates out in later generations from racial crossings; Mr. Sarkar saw it in Prussian babies and it has been reported in Hungarians and Roumanians[1]; all these European stocks contain a Mongoloid Slavic strain. In India, it is my impression that the sacral spot is rare among Anglo-Indians (as the Eurasians are called). It was absent in six Anglo-Indian babies examined last summer in Calcutta. Its occurrence in Hawaiians, Portuguese and Whites in Hawaii has been recorded by Larsen and Godfrey,[2] who also found that it segregated out in the descendants of crossings between these races in ratios that fitted a two-factor theory of inheritance for the spot, involving a dominant gene for pigment and a recessive determiner. They concluded that it is probably a universal human character, not a racial one, and that it is vestigial or rudimentary in Western Europeans.

The sacral spot has been reported in 3.78 per cent. among 11,784 babies in Turkey, mostly Turks.[3] In India, besides the Sindi twins, the spot was observed in a native of Goa from western India; in a Punjabi Sikh baby and a Muslim from the United Provinces. A Christian missionary nurse told me, in 1941, that she had seen the spot on babies of converts from various Hindu lower-castes at Gorapur, United Provinces. In a Madrasi Tamil baby examined it was absent.

It therefore seems that the sacral spot is fairly wide-spread in northern and eastern India. There is a Mongoloid aboriginal strain in Bengal and Behar, and observations on this character in Mundas, Santals and other tribes would be of interest. There were no doubt Mongoloids in the forces of the Afghans and Moghuls who long ruled northern India and Bengal.

EILEEN W. E. MACFARLANE

UNIVERSITY OF MICHIGAN

CREDIDMUS JOVEM REGNARE

PROFESSOR RITTER'S recent article on Darwin[1] brings up a question on which there has been much discussion, some of it in the nature of a lament for a view of nature which has passed. Aside from the matter of the scientific method involved, there is the point which seldom receives much consideration from biologists, and that is Darwin's recognition that, as one consequence of his hypothesis, the field of ethics must receive some attention. But if the vision of the author of Ecclesiastes was truly prophetic, we should find some other similar episode in human history. One such is to be found among the ancient Greeks, and, as in the present episode, science was held blameworthy. Perhaps the antiquity of the episode is sufficient to enable us to view it impersonally and objectively in the present.

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[1] E. Baur, E. Fischer and F. Lenz, "Human Heredity." London, 1931.

[2] N. P. Larsen and L. S. Godfrey, *Am. Jour. Phys. Anthrop.*, 10: 253–274. 1927.

[3] Henry Field, *Am. Jour. Phys. Anthrop.*, 27: 119–126. 1940.

[1] SCIENCE, 95: 58, 1942.

Burnet[2] remarks: "My aim has been to show that a new thing came into the world with the early Ionian teachers—the thing we call science—and that they first pointed the way which Europe has followed ever since, so that, as I have said elsewhere, it is an adequate description of science to say that it is 'thinking about the world in the Greek way.'"

A student, in talking with me recently, remarked that he had never seen any real definition of the scientific method, although he had heard much about it. My reply was that perhaps an idea of the scientific method was to be gained only by a study of the way in which men of science had gone about the solution of their problems. And a knowledge of how the Greeks thought about the world is to be gained only by a study of their work. But let us grant Burnet's contention, as I am more than willing to do without reservation. And passing over the controversy between him and Stace (p. vi) as to whether Parmenides was "the father of Materialism" let us look briefly at some of the consequences of "thinking about the world in the Greek way."

One great change which occurred in the period from Thales to Plato was the substitution of a world, perhaps even a universe, of law for the older world of caprice. The older, traditional view of the world broke down, and with the passing of the traditional view of nature, "the ancestral maxims of conduct" were more seriously questioned. Aristotle faced the problem of developing a system of ethics, as one result of the work of the earlier Greeks. Whether the results of Aristotle's attempts are to be regarded as wholly satisfactory or not is a question which I shall not attempt to answer. But there is evidence, drawn from his Greek and Roman successors, that his attempt was not wholly satisfactory to them.

It has been said that the aim of the Stoics was to develop a "philosophy for the practical man." Cleanthes, leading political philosopher of his day in Athens, and probably the most influential of all in the selection of candidates for university professorships, tried to stabilize the view of the world which had been attained by his time, and accused Aristarchus of Samos of impiety for suggesting a new view of the nature of the sun. There is little doubt that the Roman poet Horace, from whose ode I have taken my text, lived in an even worse time than that of Cleanthes. For some reason, the philosophy for the practical man had not worked out as the Stoics thought it might, and the older view of nature had never been fully restored. But would the substitution of Jove and his thunderbolts for the view of nature current in the time of Horace really have improved conditions very much? Or was there some other phase of the problem, some other unknown quantity in the equation? And were the men of science of previous centuries the ones most blameworthy for the development of the conditions which Horace lamented?

F. H. Pike

Columbia University

A SIMPLE METHOD OF CONTROLLING TERMITES

According to various reports termites cause damage to frame buildings in this country that amounts to millions of dollars annually. This damage could be reduced considerably if precautions were taken to prevent the termites from entering a building while it is being constructed. The author has found a very simple and inexpensive method of keeping them out of his own home, and it should be applicable to almost any building regardless of the kind of material used in its construction. At every place where the building touches the ground discarded lubricating oil drained from the crankcase of an automobile was poured into little ditches around the supporting foundation. The house used for the experiment has 56 concrete piers in the foundation. Around each of these about a quart of discarded oil was poured. A proportionate amount was poured around the base of the chimney. One place around some concrete steps was inadvertently overlooked. At this place termites entered the house, but at no other place. These were killed with fumes of chloroform, and oil was applied to the place of entry. Although the soil around the house is badly infested with termites, the building has been free from them, with the one exception mentioned, since it was built early in 1938.

The oil stays in the ground for a long time and does not diffuse more than a few inches from the little ditches. Apparently it does not affect the growth of shrubs six inches away. No doubt crude oil would give as good results as oil drained from motors.

J. C. Cross

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HUMBOLDT CURRENT IN 1941

Along the west coast of South America and in the Galapagos, there is a generally accepted tradition of a seven-year cycle associated with the Humboldt (Peru) Current. This belief has been shared by many leading scientists. The terribly destructive rains of 1925, followed by conspicuous, yet less marked phenomena in 1932 and 1939, have lent further support to this theory. But the unexpectedly heavy precipitation of January, February and March of last year, with its direct and indirect effect upon sea and animal life which I observed at the time of the Lima Assembly of the Pan American Institute of Geography and History, apparently has not been noted in scientific literature.

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[2] "Early Greek Philosophy," 4th ed., 1930, p. v.

A subsequent search into the scattered and scanty records of known periodic changes in the Humboldt Current has not yielded satisfactory results. The most illuminating record of Peruvian rains, which I have seen, appears in an article entitled "Las Lluvias en Piura,"[1] which summarizes the rains over a hundred-year period. There were six dry intervals of three years each, two of four years each, one eleven-year interval, one nine-year interval, one six-year interval, six two-year intervals, at least twelve one-year intervals and five periods of two or more successive wet years. The most thorough investigation of this region in the 'twenties and 'thirties has been made by Dr. Robert Cushman Murphy.[2]

The earlier records relating to the wet and dry cycles off the Humboldt Current area are probably not so carefully made as the data of the past fifteen years. A lamentable absence of adequate reporting stations is obvious. Yet surely, the rains of 1941 have disproved the existence of the reputed seven-year cycle.

ELIOT G. MEARS

QUOTATIONS

SCIENCE AND WAR

IN the magazine SCIENCE Dr. Peter L. Kapitza, a physicist whose name is identified with brilliant efforts to reach absolute zero, reviews the work done by Russian scientists to improve weapons and to find substitutes for much needed importations. His story parallels that which has been told by American and British scientists. If it departs from the familiar pattern it is because of its insistence on the highly practical character of Russian scientific research. Since science must serve the state in Russia, it has concerned itself with discoveries that can be applied in the factory, on the farm and in the hospital. Though this policy has made it difficult for the theorist to thrive, it is now bearing fruit in the form of highly efficient airplanes, improvements on old surgical procedures and the better utilization of raw materials. Here and in Great Britain it was necessary to mobilize science for the war effort. Russian science was mobilized by the state from the very beginning, so that the change from peace to war research was easy.

Scientists deplore war not only because it diverts attention from the urgency of problems which, if solved, would conquer baffling diseases and shed much needed light on the structure of the universe, the nature of matter, the mystery of life, but also because it exploits science. Dr. Kapitza strikes a different note. As he sees it, science derives much inspiration from war. He makes much of the Haber process for synthesizing ammonia—a process which not only enabled Germany to stave off defeat during the last war but which gave her fertilizers. He might have gone farther. The laws of gravitation were derived from ballistics as much as from swinging pendulums. Studies of the gases liberated when guns are fired gave both chemistry and physics an enormous impetus. Blood banks and the control of typhus came out of war, and so did some of the new techniques for operating on the brain and for repairing head injuries.

It is worth noting that the only institutions where science was systematically taught during the eighteenth century were the artillery schools of France; that the heavy chemical industry was created when Leblanc met an urgent wartime need for soda; that the earliest sewing machine, that of Thimmonier, was first used in making uniforms; that synthetic rubber, synthetic gasoline and the whole coal-tar chemical industry were developed by Germany with an eye on the inevitable British blockade. What gains science may make as the result of the present war no one can predict with certainty. Already it is clear that new plastics of startling properties will be developed, that a healthy synthetic rubber industry will be established, and that new synthetic drugs will take the place of those which we have hitherto extracted from imported plants.—*The New York Times* for April 19.

SCIENTIFIC BOOKS

ORGANIC CHEMISTRY

The Chemistry and Manufacture of Cosmetics. By MAISON G. DE NAVARRE. xix + 745 pp., with numerous illustrations and tables. New York: D. Van Nostrand Co., Inc. 1941. 8.00.

THE book opens with a Foreword by Dean Roland

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[1] *Boletin de la Sociedad Geografica de Lima*, Tomo IV, 1894.

[2] *Geog. Rev.*, 16: 26–54, 1926, and 29: 1–33, 1939.

T. Lakey, of Wayne University College of Pharmacy, and concludes with a chapter by Ralph J. Mill on the Federal Food, Drug and Cosmetic Act of 1938 as it relates to cosmetics.

As both a text and a reference work, it should be valuable to all interested in its field, whether as students, technicians, sales organizations or manufacturers. It does not aim to be a cookbook or formulary, but to supply the basic information which will enable any intelligent individual to work out his own formulas, and produce cosmetics which shall serve some useful purpose, be entirely non-toxic and stable, with potent sales appeal, and complying with existing municipal, state and federal regulative legislation.

As the author points out, in the case of both perfumes and cosmetics, what would seem to the layman like wholly negligible infinitesimal minutiae often have a great and wholly unsuspected influence upon the character of the final product. This applies not only to its physical appearance and character, but in highest degree to variations in odor, because our marvelous olfactory equipment is such an extremely delicate analytical instrument. Since nature never standardizes her products, which vary from season to season, with variations of soil, climate, temperature, rainfall, fertilizer, etc., the duplication of results is much more difficult with natural than with synthetic products. The activities of scientists, particularly the organic chemists, are constantly making available new substances of immediate value to the cosmetic industry.

In the Introduction, cosmetics are divided into creams, lotions, powders, make-up, soaps and miscellaneous. Each of these in turn is subdivided into various types. Thus, there are three types of creams —cold creams, vanishing creams and waterfree creams; three of lotions—non-alcoholic with gum, strongly alcoholic with no gum and mildly alcoholic; two types of powders—face powder and miscellaneous; two of soaps—shaving cream and shampoo; four of make-up—eye, lip, cheek and entire face; and miscellaneous types include permanent wave, dental, depilatory, bath, mask, manicure and suntan.

The subject matter of the volume is arranged in ten parts (or chapters). Part I deals with metrology and alligation; Part II with the equipment for small manufacture and cosmetic materials; Part III with fundamental chemical, bacteriological and mycological problems; Part IV with preservatives, antioxidants, corrosion, etc.; Part V with cosmetic colors; Part VI with emulsions; Part VII with the detailed description of the different types of creams, lotions, powders, etc.; Part VIII with the physiology of the skin, scalp and hair; Part IX with the Federal Food, Drug and Cosmetic Act of 1938, as mentioned above; and Part X contains the Appendix (supplementary illustrations, tables and other data), Bibliography and Index.

The usefulness of the book is greatly enhanced by numerous cosmetic formulas, patent digests, illustrations, tables, extensive bibliographies and frequent literature references throughout the text. It is a cyclopedia of information about a business as old as man himself, and which at least the female part of our population will undoubtedly still insist constitutes an "essential industry." Paper, presswork and binding are excellent.

A Brief Course in Organic Chemistry. A Combined Text-book and Laboratory Manual. By Reynold C. Fuson, Ralph Connor, Chas. C. Price and H. R. Snyder. x + 248 pp. 6 × 9¼ in. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1941. $2.50.

Inasmuch as three of the authors are members of the chemistry staff of the University of Illinois, and the fourth (Connor), although now at the University of Pennsylvania, was trained at the same institution, this book presumably reflects the considered judgment of representatives of one of the best-known and most distinguished departments of organic chemistry in our country. As such, it merits and will receive from other organic chemists a cordial welcome and a careful consideration.

One of the major problems in the preparation of a "brief" course in organic chemistry is the immense amount of material from which the selection must be made, and the improbability that all organic chemists will agree on all the details, either as to the topics chosen or the order of their arrangement. For example, in the matter of the sequence of the chapters, the reviewer feels that, based upon structural considerations, the phenols should follow the alcohols, and the carbohydrates and quinones the aldehydes and ketones, before taking up the acids, amines, amino acids and proteins. The joint authorship of the book under review indicates that four leaders in the field have together worked out the problem, to their own satisfaction at least, and this in itself should carry weight with those considering its adoption for use in introductory lecture and laboratory courses.

As the authors state, "this text has been developed in conducting courses for students of agriculture, home economics, veterinary medicine, pre-dentistry and pre-medicine." The plan of presentation is to introduce as early as possible fundamental concepts and the more important types of compounds, in order that the beginner may acquire a working knowledge of the language of organic chemistry, an early mastery of the elements of the subject and a rapidly increasing grasp of the scope and character of the field.

As stated in the title, the volume is both a lecture text-book and a laboratory manual. The first 183 pages, covering the lecture portion, is followed by 52 pages of Laboratory Directions and Experiments.

The chapters discussing the theoretical side are devoted, in this order, to (I) Methane and its Derivatives, (II) Saturated Hydrocarbons, (III) Unsaturated Hydrocarbons, (IV) Aromatic Hydrocarbons, (V) Alcohols, (VI) Ethers, (VII) Aldehydes, (VIII) Ketones, (IX) Acids and Derivatives, (X) Optical Isomerism, (XI) Carbohydrates, (XII) Amines, (XIII) Amino Acids and Proteins, (XIV) Phenols, (XV) Quinones and (XVI) Heterocyclic Compounds. These chapters are followed by two dealing with some of the outstanding industrial developments of organic chemistry: (XVII) Industrial Developments in Aliphatic Chemistry and (XVIII) Coal Tar Products. A chapter (XIX) is then assigned to Structure and Valence, and one (XX) to Natural Products.

In the experimental portion, after general laboratory directions, discussions of melting points, boiling points and crystallization, 23 experiments are described in detail, for the preparation of individual or groups of organic compounds, or a study of their reactions, each of these experiments concluding with a list of suggestive and helpful questions. The particular experiments given were selected with special reference to the interests of the groups of students for whom the book is primarily intended.

The scientific repast it offers to beginners is assuredly most attractive and, in those who partake, should arouse a keen appetite for more courses from the same cuisine.

Paper, presswork and binding are excellent.

Organic Analytical Reagents. By JOHN H. YOE and LANDON A. SARVER. ix + 339 pp. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1941. $4.00.

THE authors explain that their purpose in writing this book was to furnish an up-to-date bibliography on organic analytical reagents and, based upon the literature thus assembled, to discuss the theoretical aspects of the subject and to suggest further research in this important field.

One of the most promising sources of new and valuable analytical reagents certainly exists in the vast number and illimitable variety of organic compounds. In that domain are to be found specific and highly sensitive reagents for gravimetric, colorimetric and nephelometric determinations; primary standards and indicators for volumetric analysis; pH indicators, buffers, protective colloids, flocculating agents, oxidizing and reducing agents, etc.

The volume consists of two parts. Part I is descriptive and theoretical. Part II consists of Glossary, Bibliography and Index. In Part I, the organic analytical reagents are classified into solvents and wash liquids, substances used in neutralizations, oxidizing agents, reducing agents, indicators, primary standards, acidic and basic salinogenic compounds, photometric aids and substances for the control of adsorption, diazotization and coupling agents, alkaloids and natural products.

First is given a list of all the compounds in each of these categories, arranged according to chemical character. This is followed by separate chapters for each (or several) of these classes, in which the appurtenant reagents are described seriatim and in detail, both as to their properties and their applications.

In Part II there is found a very helpful tabulation of all these various reagents, arranged alphabetically under each chemical element to which they apply, which elements likewise are printed in alphabetical order. This is followed by a Glossary of some 750 organic reagents, and a Bibliography of 2,419 titles. No laboratory procedures are included in the volume.

The book can be cordially recommended as a compact and useful reference work on organic analytical reagents. Paper, presswork and binding are excellent.

MARSTON T. BOGERT

COLUMBIA UNIVERSITY

REPORTS

FELLOWSHIPS IN SCIENCE AWARDED BY THE GUGGENHEIM FOUNDATION

EIGHTY-TWO John Simon Guggenheim Memorial Fellowships carrying awards amounting to $196,600 to American and Canadian scholars and creative workers have been announced. In making these appointments the trustees of the foundation adopted a resolution that all these fellows of the foundation should be informed that their use of their fellowships is subject to the requirements of any National Service for which they may be required; and the foundation's position is, further, that if any fellow is required for any National Service in a manner and of a kind such that his fellowship stipend would contribute to the war effort he may use the fellowship funds granted him while doing the work which the Government wants him to do.

This is the seventeenth annual series of fellowship awards by the foundation which was established and endowed by the late U. S. Senator Simon Guggenheim and by Mrs. Guggenheim as a memorial to their son John. More than 1,500 applications were received this year.

The fellowships are granted to research workers, scholars, artists and others who by their previous work have shown themselves to be persons of unusual ability. Men and women, married and unmarried, of all races and creeds who are citizens or permanent residents of the United States, citizens of Canada and of certain Latin American countries, are eligible on equal terms. The fellows are normally of ages between twenty-five and forty years. The stipends are usually $2,500 for a year.

Since its establishment seventeen years ago the foundation has granted 1,210 fellowships with stipends amounting to $2,488,000.

The trustees of the foundation are Mrs. Simon Guggenheim, Francis H. Brownell, Carroll A. Wilson, Charles D. Hilles, Roger W. Straus, Charles Earl, John C. Emison and Medley G. B. Whelpley.

The Committee of Selection consisted of Dr. Frank Aydelotte, director of the Institute for Advanced Study, *Chairman*, Dr. Florence R. Sabin, of the Rockefeller Institute for Medical Research; Professor Edwin Bidwell Wilson, of the Harvard University School of Public Health; Professor Linus Pauling, of the California Institute of Technology, and Professor Wallace Notestein, of Yale University.

The fellows chosen this year come from twenty-two states and Hawaii, and from two Canadian provinces; and they are members of the staffs of thirty-six educational institutions.

Fellowships awarded in the sciences are:

FOR WORK IN BIOLOGY

Dr. Thomas Rogers Forbes, instructor in anatomy, the Johns Hopkins University Medical School: Studies of the physiology of reproduction.

Dr. Robert Gaunt, assistant professor of biology, New York University: Studies of the functional control of the adrenal cortex.

Dr. Salvador E. Luria, research assistant in surgical bacteriology, Columbia University: Studies of certain biological and physico-chemical properties of bacteriophage.

Dr. Jane Marion Oppenheimer, instructor in biology, Bryn Mawr College: Studies of the development of structure and function in the central nervous system of fishes.

Dr. Simon Dworkin, lecturer in physiology, McGill University, Montreal: The preparation of a monograph comparing the higher nervous activity of dog, cat and rat, as revealed by the experimental method of conditioned reflexes.

Dr. Charles Leonard Huskins, professor of genetics, McGill University: The preparation of a book on the cytology and genetics of plants, animals and man.

Dr. Floyd Alonso McClure, professor and curator of economic botany, Lingnan University, Canton, on leave in the United States: The preparation of a book on the Chinese bamboos.

Dr. David R. Goddard, associate professor of botany, University of Rochester: A study of the respiratory enzymes of higher plants.

Dr. John Thomas Curtis, assistant professor of botany, University of Wisconsin: Studies of the ecological status of the "Lake Forest" of Michigan, Wisconsin, Minnesota and Ontario.

Dr. Hugh Carson Cutler, research associate, Botanical Museum, Harvard University: An attempt to determine the location of the area in which corn originated.

Dr. Richard Evans Schultes, research associate, Botanical Museum, Harvard University: Studies of the economic aspects of the flora of southern Colombia and the adjacent part of Ecuador; and an ethnobotanical study of the useful plants, cultivated and wild, among Indian tribes of the same area.

Dr. Rolf Singer, research associate in mycology, Harvard University: Studies of the mycological flora of subtropical America.

Dietrich Bodenstein, research associate in biology, Stanford University: Investigations of the problem of metamorphosis in insects, with special emphasis on the rôle of hormones in development.

Dr. E. Raymond Hall, associate professor of vertebrate zoology and curator of mammals, University of California, Berkeley: Preparation of a monograph on the American weasels.

Dr. Hans Jenny, professor of soil chemistry and morphology, University of California: A study of the relation between nitrogen and organic matter content of soils and annual precipitation in the tropics.

FOR WORK IN GEOLOGY

Dr. Max Harrison Demorest, instructor in geology, Wesleyan University: Studies of the physics of ice, in particular, studies of the structure and flow of glacial ice.

Dr. George Prior Woollard, geophysicist, Princeton, N. J.: Seismic, gravitational and magnetic investigations of the geologic structure underlying the North American Atlantic coastal plain.

Dr. Wilson Marcy Powell, assistant professor of physics, Kenyon College, will continue his studies of cosmic rays, on the top of Mount Evans, Colorado.

FOR WORK IN ANTHROPOLOGY

Dr. Gordon Townsend Bowles, assistant professor of anthropology, University of Hawaii: Studies of functional adaptations in the human skeleton, based on Hawaiian skeletal materials.

Dr. Morris Edward Opler, assistant professor of anthropology, Claremont Colleges: The preparation of a book on the cultures of four related Apache Indian tribes of the Southwest.

FOR WORK IN PSYCHOLOGY

Dr. Robert Brodie MacLeod, associate professor of psychology, Swarthmore College: Studies of the psychology of color vision.

Dr. Burrhus Frederic Skinner, associate professor of psychology, University of Minnesota: The completion of a book on the psychology of language.

Dr. Rudolf Arnheim, psychologist, New York City: Studies of the application of the principles and methods of gestalt psychology to art analysis.

FOR WORK IN MATHEMATICS

Dr. John Charles Chenoweth McKinsey, instructor in mathematics, New York University: Studies of the basic concepts and logical foundations of mathematics, and by *Dr. Alfred Tarski*, the Polish refugee mathematician. Both will work at the Institute for Advanced Study, Princeton, N. J.

SPECIAL ARTICLES

A NEW PROCEDURE FOR STAINING VAGINAL SMEARS[1]

IN the course of a study of vaginal smears conducted in cooperation with Dr. Herbert F. Traut, of the Department of Gynecology of Cornell Medical College and of New York Hospital, for the purpose of diagnosing malignant tumors and other pathological conditions of the female genital tract,[2] it was realized that certain modifications and improvements in our procedure of staining vaginal smears were necessary. Methods which proved to be successful in other applications[3,4,5] were not found to be entirely satisfactory in this particular work because of a common disadvantage. The staining of the cells was too deep to permit a sharp definition of their outlines in smears that were relatively thick or contained much blood. In most cases of carcinomas and in many other pathological conditions there is a profuse vaginal discharge frequently mixed with blood which forms a heavy film on the slides. In such rich and bloody smears there is considerable crowding and overlapping of cells which, when deeply stained, can not be well differentiated. This applies more particularly to the small endometrial cells which are often found in menstrual and other uterine bleedings and have a pathognomonic value in the diagnosis of adenocarcinomas of the fundus[2] and of other gynecological conditions. These cells also have great importance in the evaluation of the normal menstrual cycle, of sterility and of estrogenic and other endocrine therapy.

After long experimentation it was found that a much greater transparency and an equally good color differentiation of the cells can be obtained by the use of solutions of stains in 95 per cent. alcohol instead of aqueous solutions. Various alcoholic stains were thus developed, but here only two will be described which are now being used more generally in our laboratory (see Table I).

TABLE I

			Stain E A 36	Stain E A 25
Light green SF yellowish	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent. alcohol	45 cc	44 cc
Bismarck Brown	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent. alcohol	10 cc	12 cc
Eosin yellowish	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent. alcohol	45 cc	44 cc
Acid phosphotungstic	Merck		0.200 gm	0.170 gm
Lithium carbonate, saturated aqueous solution			1 drop	1 drop

The 0.5 per cent. alcoholic solutions are first prepared. As the solubility of the stains in 95 per cent. alcohol is low, the solutions are heated at the time of preparation. The solutions are kept in stock without being filtered. Stains EA 36 or EA 25 should, however, be filtered in order to eliminate undissolved particles of stain.

The staining procedure is as follows:

1. Fix smears immediately (before drying) in equal parts of 95 per cent. alcohol and ether for 5 to 15 minutes.[6] Rinse in 70 per cent. and 50 per cent. alcohols and in distilled water.

2. Stain in hematoxylin for 5 to 10 minutes.[7] Rinse

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[1] From the Department of Anatomy, Cornell University Medical College, New York, N. Y. Aided by a grant by the Commonwealth Fund.

[2] G. N. Papanicolaou and H. F. Traut, *Jour. Obst. and Gyn.*, 42: 193, 1941.

[3] G. N. Papanicolaou, *Amer. Jour. Anat.*, 52: 519, 1933.

[4] E. Shorr, SCIENCE, 91: 321, 1940; *ibid.*, 91: 579, 1940; *ibid.*, 94: 545, 1941.

[5] G. N. Papanicolaou, *Jour. Lab. and Clin. Med.*, 26: 1200, 1941.

[6] Although smears may be kept in the fixative indefinitely, a prolonged fixation of a week or more affects the staining reaction of the cells.

[7] Staining for only 2 minutes is often sufficient, but, as a rule, better results are obtained with longer staining of 5 to 6 minutes for normal smears and of 8 to 10 for smears used for diagnostic purposes, more particularly for cancer diagnosis. For sections, even longer staining is advised. This timing applies more specifically to Harris Hematoxylin, prepared with domestic hematoxylin and ammonium alum, which is now used in our laboratory. In order to obtain more uniform staining, used hematoxylin should not be discarded, but filtered from time to

in distilled water. Rinse 3 to 4 times in 0.5 per cent. aqueous solution of hydrochloric acid. Rinse thoroughly in water. Leave for 1 minute in a weak solution of lithium carbonate (3 drops of a saturated aqueous solution per 100 cc of water). Rinse thoroughly in water.

3. Rinse in distilled water, then in 50 per cent., 70 per cent., 80 per cent. and 95 per cent. alcohols.

4. Stain for 1 minute in the following solution (OG 6):[8]

5. Rinse 5 to 10 times in each of two jars containing 95 per cent. alcohol, to remove excess stain.

6. Stain in EA 36 or EA 25 for 2 minutes.

7. Rinse 5 to 10 times in each of three jars containing 95 per cent. alcohol. (Do not use the same alcohol which was used after Orange G.) Rinse in absolute alcohol and xylol. Mount in Clarite, Canada Balsam or Gum Damar.

The advantages offered by this staining method are the following: (1) The epithelial cells and the erythrocytes are more transparent. Overlapping cells can be more easily differentiated. (2) The color of the acidophilic cells varies from red to orange. This helps in the identification of certain smear types. Basophilic cells stain green or blue-green. (3) Cells or fragments of tissue penetrated by blood take a characteristic orange or orange-green color which permits an easier recognition of small amounts of blood, even when erythrocytes are not distinctly seen. (4) Smears which were subjected to partial or even complete drying can be stained fairly satisfactorily. The differential coloring is not entirely lost.

Stains EA 36 or EA 25 can be used for short staining by those who want to make an immediate examination of a slide. No fixative needs to be used. The slides are dipped directly in the staining solution or covered by stain contained in a dropping bottle. The smears are thus fixed and stained simultaneously within a few minutes, although they may be kept in the stain for a longer time without being overstained. The excess stain is washed off in 95 per cent. alcohol and then the slides are carried through absolute alcohol and xylol and mounted in Clarite. The nuclei are stained faintly, but the cells show good differential staining and retain their transparency. Smears stained by this simple method can be restained by a repetition of the procedure described in this paper, including hematoxylin. This will improve the nuclear staining as well as the cellular differentiation and will permit the use of the same smears for a more detailed cytological study.

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FERRITIN AND APOFERRITIN

LAUFBERGER[1] discovered in 1937 an iron-containing protein extracted from horse spleen, containing about 20 per cent. iron. The compound was studied in more detail by Kuhn, Sorensen and Berkofen.[2] Our own investigation was started primarily with respect to the magnetic properties of this compound. In this preliminary note, however, we restrict ourselves to the statement of the result that the iron atom, which is in the ferric state, has a dipole moment of 3.8 Bohr magnetons per g-atom of Fe and thus is probably another representative of those rare ferric compounds with three unpaired electrons of which Pauling and Coryell[3] discovered one in the form of ferrihemoglobin hydroxide (alkaline) methemoglobin and we[4] another in the form of catalase. This note is more concerned with another very remarkable property of ferritin found on the occasion of these studies.

The crystals of ferritin obtained by adding $CdSO_4$ to its solution are, although rather insoluble in pure water, yet easily soluble in 0.5 to 1.0 per cent. ammonium sulfate solution from which they can be recrystallized by addition of $CdSO_4$. The iron in the ferric state is rather stable but can be gradually reduced to the ferrous state by sodium hydrosulfite ($Na_2S_2O_4$, sodium dithionite). When a solution of ferritin is mixed with $Na_2S_2O_4$, a sufficient amount of α, α′-dipyridyl and some acetate buffer of pH 4.6 is added to avoid alkaline reaction, the iron is gradually removed from the protein in the form of the soluble red ferrous dipyridyl complex which can be separated from the protein by dialysis. According to the period of time used for this process one can obtain protein solutions which after addition of $CdSO_4$ within a minute or so yield crystals of the same shape as originally, but more or less decolorized, and finally even quite colorless solutions and crystals. This iron-free protein will be referred to as *apoferritin*. The possibility of obtaining crystals of variable iron con-

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time. The loss from filtering and evaporation is gradually replaced by the addition of fresh stain.

[8] The addition of phosphotungstic acid to the Orange G solution intensifies the orange color. For normal slides a slight acidification of 0.010 gm per 100 cc (OG 8) or 0.015 gm per 100 cc (OG 6) is suggested. For cancer diagnosis a higher acidification of 0.025 gm per 100 cc (OG 5) is often preferable, as it gives a sharper contrast of the abnormal cell types.

Orange G	National Aniline and Chemical Co.	0.5 per cent. solution in 95 per cent alcohol	100 cc
Acid phosphotungstic	Merck		0.015 gm

[1] Laufberger, *Bull. Soc. Chim. Biol.*, 19: 1575, 1937.

[2] Kuhn, Sorensen and Berkofen, *Ber.*, 73: 823, 1940.

[3] Pauling and Coryell, *Proc. Nat. Acad. Sci.*, 22: 159, 210, 1936.

[4] Michaelis and Granick, *Jour. Gen. Physiol.*, 25: 325, 1941.

tent will explain why the iron analyses of various preparations may differ somewhat from each other. Taking 23 per cent. Fe as the maximum value, one may say that 23 per cent. dry weight of the crystals is iron. On removing Fe^{+++}, one may either imagine their replacement by protons, or their removal in the form of a hydroxide such as FeO(OH). Accordingly, either 23 per cent. or 36 per cent. of the mass of the crystal can be removed without essentially altering the very characteristic crystal shape. One may imagine how large is the volume occupied by non-protein interstices within the crystal lattice made up by the protein part. These interstices may be filled either by water or by ferric hydroxide without any obvious influence on the crystal lattice. One may imagine what amount of "impurities" or non-protein constituents can adapt themselves into the interstices of a protein crystal, and how critical one should be with respect to the homogeneity and "purity" of a crystallized protein. This critical aspect, of course, is not all novel. So, pepsin may be more or less acetylated[5] without influence on the shape of the crystals. Yet the present case shows this phenomenon to an extent unappreciated heretofore.

On the other hand, it would be quite absurd to consider the iron of ferritin simply as a contamination of the protein. Rather may one say that the specific structure of apoferritin is adapted to the task of fixing iron atoms in the ratio of about one half to one Fe to each peptide link, without losing the specific structure. It is easy to understand that the space between the four N atoms of a porphyrin allows one Fe atom to be enclosed without loss of the porphyrin structure, but it is hard to imagine a structure of a protein allowing the building in of iron to that enormous extent as found in ferritin. One can not exclude the possibility that a cluster of many molecules of ferric hydroxide such as are known to represent a micelle of a colloidal ferric hydroxide solution, form a center surrounded by apoferritin molecules, reminding one of the very open structures of the zeolites. Such an assumption would dispense with the necessity of linking almost each peptide group with an Fe atom. Study of the crystal structure may be able to decide this point.

The iron content of ferritin is rather constant, *i.e.*, within 2-3 per cent. Ferritin from a normal horse was compared with that from a horse which had been subjected to many bleedings. Although the yields of ferritin obtainable from the two horses differed by 10 : 1, the Fe content of the ferritin was the same. At present we have no evidence for the existence of apoferritin as such in the spleen. That ferritin is not an artefact due to the method of preparation can be seen from the fact that the juice of spleen mixed with $CdSO_4$ without any other treatment yields crystals of ferritin.

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[5] Northrup, ''Crystalline Enzymes,'' Columbia University Press, 1939.

THE PRODUCTION OF ANTIBODIES IN VITRO

BY following the general procedure proposed in connection with a theory of serological phenomena,[1] we have succeeded in making antibodies in the laboratory.

The procedure consists in subjecting normal globulin or other protein to the action of denaturing reagents or conditions in the presence of an antigen. The protein molecule unfolds, and then refolds in such a way as to assume a configuration complementary to that of the antigen, thus acquiring the properties of a specific homologous antibody.

Bovine γ-globulin was the protein used in most of our experiments. Some success was obtained also with other serum globulin fractions and with serum albumin. As antigens there have been used the triphenylmethane dye methyl blue (a mixture of the *p*-trisulfonated and disulfonated triphenylpararosanilines), the azo dye 1,3-dihydroxy-2,4,6-tri(*p*-azophenyl-arsonic acid) benzene, and pneumococcus polysaccharide type III. Successful experiments were made by addition of alkali (to pH 11) and slow return to neutrality, by addition and slow removal of urea, and by heating to about 65° and slowly cooling; some success was also obtained by surface denaturation. The most satisfactory of the treatments tried was that of holding a solution of protein and antigen for several days at about 57°; this temperature seems to be high enough to cause the protein chains to unfold and to refold under the influence of the antigen into specific complementary configurations.

In one experiment a solution containing 0.01 per cent. of the azo dye mentioned above and 1 per cent. of bovine γ-globulin was held at 57° for about 14 days, then removed from the bath, and dialyzed through Cellophane against 1 per cent. salt solution. Some precipitate formed during the heating and more during the dialysis. The mixture was then dialyzed against a 1 per cent. solution of the haptene arsanilic acid, which was changed several times. Most of the precipitate dissolved during this dialysis; that which remained was discarded. The solution, which was free of dye, was then dialyzed against 1 per cent. salt solution to remove the haptene.

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[1] L. Pauling, *Jour. Am. Chem. Soc.*, 62: 2643, 1940.

The resulting protein solution was found to have many properties of an antiserum specific to the phenylarsonic acid group. It gave precipitates with multihaptenic dyes and azoproteins containing this group, and not with other dyes or azoproteins, and the specific precipitates were dissolved by excess of dyes or haptenes containing this group but not by other dyes or haptenes, such as those containing the phenylsulfonic acid group.

A solution of 1 per cent. pneumococcus polysaccharide type III and 1 per cent. bovine γ-globulin was similarly held at 57° for 14 days. Some precipitate formed, which was removed. The resultant solution was found to precipitate type III polysaccharide but not types I or VIII (cross-reaction with type VIII was thus not shown) and to agglutinate pneumococci type III but not types I or II. Purified antibody solutions were made by adding 15 per cent. salt and bringing to pH 4 or adding 15 per cent. salt, calcium chloride, and calcium hydroxide to pH 8, thus precipitating polysaccharide and some protein. Each of the two solutions, after dialysis against 1 per cent. salt solution, was found to precipitate type III polysaccharide but not types I or VIII and to agglutinate type III pneumococci but not types I or II. Mouse protection tests and swelling tests have not yet been carried out.

We acknowledge with thanks the support of a grant from the Rockefeller Foundation, the assistance of Dr. David Pressman, and the courtesy of Dr. W. Goebel in providing material.

Our experiments are being continued.

LINUS PAULING
DAN H. CAMPBELL

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF THE COMPLEMENT FIXATION TEST IN ROCKY MOUNTAIN SPOTTED FEVER

THE clinical differentiation between typhus fever and Rocky Mountain spotted fever may be difficult, especially when both diseases occur in the same region. The laboratory diagnosis may be made by the isolation of the virus from the patient, but this can only be satisfactorily performed if guinea pigs are inoculated immediately upon withdrawal of the blood. The agglutination test, using either typhus or Rocky Mountain spotted fever Rickettsiae is not satisfactory, while the Weil-Felix agglutination with Proteus OX 19 may indicate the presence of a Rickettsial disease, but a differentiation between typhus and Rocky Mountain spotted fever can not be made. It is for these reasons that a specific complement fixation reaction may be of value in distinguishing these two diseases.

Castaneda[1] prepared an antigen from the peritoneal washings of x-rayed rats inoculated with endemic Rickettsiae and reported positive complement fixation in typhus fever. Bengtson[2] described a specific complement fixation reaction for "Q" fever and endemic typhus, using an antigen prepared with Rickettsiae grown in the yolk sac of developing chick embryos (Cox method).[3] No satisfactory antigen for Rocky Mountain spotted fever had previously been prepared and it is the purpose of this communication to describe a specific complement fixation test which may be used in this disease.

The sera used in the tests were obtained from recovered human cases of Rocky Mountain spotted fever, "Q" fever and Brill's disease and from guinea pigs recovered from infections with Rocky Mountain spotted fever, endemic typhus, European typhus and "Q" fever. As controls, human sera were obtained from several different febrile diseases, strongly Wassermann positive sera, as well as normal sera. Likewise, normal guinea pig sera were used.

Two antigens, which were equally satisfactory, were prepared from tissue cultures grown by the semisolid agar method in Kolle flasks.[4, 5] The cultures were initiated with infected guinea pig spleen and grown in contact with ten-day chick embryo cells. Transplants were made every seven days by scraping off the infected cells from the surface of the medium and grinding in a tube with alundum. This material was again brought in contact with normal chick embryo cells. After several transplants, the cultures became exceedingly rich, so that a considerable number of Rickettsiae were seen in every field. The antigens employed were made from the 25th to the 35th transplant. Five cubic centimeters of a 1:10,000 merthiolate solution in saline was used to wash off the cells from each Kolle flask. When a certain amount of material was obtained, the Rickettsiae were extracted in the following manner. One batch was ground up in the Waring Blender and then frozen and thawed five times. The other was shaken in a large Pyrex flask with glass beads. The Rickettsial suspensions were then centrifuged in an angle centrifuge at 1,500 r.p.m. for 30 minutes. The supernatant fluid was removed and centrifuged at 4,500 r.p.m. for one hour. The sediment was then resuspended in 0.85

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[1] M. Castaneda, *Jour. Immunology*, 31: 285–291, 1936.

[2] I. Bengtson, *Proc. Soc. Exp. Biol. and Med.*, 46: 665–668, 1941; *Pub. Health Reports*, 56: 649–653, 1941; *Pub. Health Reports*, 56: 1723–1727, 1941.

[3] H. R. Cox, *Pub. Health Reports*, 53: 2241–2247, 1938.

[4] Zinsser, Fitzpatrick and Wei, *Jour. Exp. Med.*, 69: 179, 1939.

[5] Zinsser, Plotz, Enders, SCIENCE, 91: 51–52, 1940.

per cent. saline to one fifth of the original volume. The final preparation contained a heavy suspension of Rickettsiae.

The antigen was titrated with a known guinea pig serum as well as with two known human sera. A 4 plus fixation was obtained with dilutions of the antigen up to 1: 6. The antigen was found to be anticomplementary in a dilution of 1: 2. An antigen dilution of 1: 4 was used in all tests.

The usual hemolytic system, consisting of sheep cells, guinea pig complement and rabbit anti-sheep cell amboceptor was employed. The amboceptor was diluted to contain 3 M.H.D. in 0.25 cc. Equal amounts of amboceptor dilution and a 3 per cent. suspension of sheep cells were mixed together. The fresh complement was titrated on the day of the test.

Sera were inactivated at 56° C. for 30 minutes. Serum dilutions were made ranging from 1: 3 to 1: 192 using 0.25 cc amounts of each dilution in the test. Complement was diluted to contain 2 full units in 0.5 cc. A suitable antigen dilution was added in 0.25 cc amounts. Fixation was carried out for 20 hours in the ice box (4° C.) following which 0.5 cc of sensitized sheep cells were added to each tube and incubated for 30 minutes at 37° C. One and two units of complement in the presence of 0.25 cc of antigen dilution were also set up to indicate the validity of the results by showing the actual amount of free complement at the time the hemolytic system was added. The results of the tests are shown in Table 1.

TABLE 1

Human sera	Date of illness	Disease	1 : 3	1 : 6	1 : 12	1 : 24	1 : 48	1 : 96	1 : 192	Serum control
RO	1941	R.S.F.	4	4	4	4	4	2	1	0
WE	1938	R.S.F.	4	4	4	3	2	0	0	0
PA	1940	R.S.F.	4	4	3	2	1	0	0	0
SH	1941	R.S.F.	4	4	4	4	4	3	2	0
SM	1940	R.S.F.	4	4	4	4	3	2	1	0
RA	1941	R.S.F.	4	4	4	4	4	2	1	0
HO	1941	R.S.F.	4	4	4	4	4	4	2	0
HU	1937	R.S.F.	4	4	3	2	–	–	–	0
LO	1941	R.S.F.	4	4	4	4	3	2	–	0
2 cases		Brill's	0	0	0	0	–	–	–	0
11 sera	Various febrile cases		0	0	0	0	–	–	–	0
8 sera	Wassermann positive		0	0	0	0	–	–	–	0
2 sera	"Q" fever		0	0	0	0	–	–	–	0
11 sera	Normal		0	0	0	0	–	–	–	0

We have examined the sera from nine cases of Rocky Mountain spotted fever and obtained positive complement fixation reactions in all. The oldest case (HU) had the disease 4½ years prior to the examination of the serum, while the most recent serum (LO) examined was obtained on the 12th day of illness. This latter finding is significant, for if in subsequent cases it can be shown that antibodies can be demonstrated so early in the disease the complement fixation test may prove to be a real aid in diagnosis. In three cases, (PA), (SH) and (SM), several specimens of serum were examined over a period of three and six months and no significant change in titre was noted.

There were two cases where the possible diagnosis of typhus fever was made. The subsequent course of the disease, a negative fixation test for typhus fever and a positive test for Rocky Mountain spotted fever indicated that we were dealing with the latter disease.

TABLE 2

Guinea pig sera	Disease	1 : 3	1 : 6	1 : 12	1 : 24	1 : 48	1 : 96	1 : 192	Serum control
No. 761	6 days after drop Temp.	0	0	0	0	–	–	–	0
" 743	12 days after drop Temp.	4	4	3	3	2	0	0	0
" 379	R.S.F.	4	4	4	4	3	1	0	0
" 489	R.S.F.	4	3	3	2	1	–	–	0
" 277	R.S.F.	3	3	2	1	1	–	–	0
" 220	R.S.F.	4	4	4	4	3	1	0	0
" 486	R.S.F.	4	4	4	4	3	2	0	0
" 498	R.S.F.	4	4	4	3	1	0	0	0
" 490	R.S.F.	3	2	2	1	–	–	–	0
7 sera	Endemic	0	0	0	0				0
6 sera	Epidemic	0	0	0	0				0
3 sera	"Q" fever	0	0	0	0				0
15 sera	Normal	0	0	0	0				0

In guinea pigs (Table 2), fixation was obtained with eight sera. It is of interest to note that one guinea pig gave a negative reaction six days after the return of temperature to normal, while another gave a positive test after twelve days. The occurrence of fixing antibodies during the course of the illness in guinea pigs and monkeys is now being studied. No fixation was obtained with sera from endemic typhus, epidemic typhus or "Q" fever.

The results obtained in the tests described indicate that the complement fixation test may be employed in diagnosing Rocky Mountain spotted fever.

HARRY PLOTZ
KENNETH WERTMAN

ARMY MEDICAL SCHOOL

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METALS IN NATIONAL DEFENSE[1]

By Dr. ZAY JEFFRIES

GENERAL ELECTRIC COMPANY

WHEN near the middle of 1940, the Advisory Commission to the Council of National Defense was established, it was only natural that great stress was put on the importance of metals and minerals and equally natural that Dr. C. K. Leith should find himself in the center of this activity. Dr. Leith has made a profound study of the relationships between minerals and war. He has served the government, directly and indirectly, for more than a quarter of a century and, for the past twenty years, he has advocated the stock-piling of such minerals as are not obtainable or of which there is a deficiency in the Western Hemisphere. He has eloquently pointed out that the nations controlling the great mineral deposits of the world should lead in both industrial and war strength; that no continent is self-sufficient in all the minerals necessary for either a complete industrial development or the most efficient prosecution of war; that the mineral distribution is such that no continent can obtain all the necessary minerals without sea transportation, and hence that the value of sea control can hardly be overestimated.

Dr. Leith early called on the National Academy of Sciences for technologic help on manganese and tin. By February, 1941, the problems were multiplying to such an extent that he asked the academy to arrange for a comprehensive organization to provide the Office of Production Management, successor to the Advisory Commission, with advice on metals and minerals.

Dr. Frank B. Jewett, the president of the academy, created such an organization known as the Advisory Committee on Metals and Minerals of the National Academy of Sciences and the National Research Council. Mr. Clyde Williams, head of Battelle Memorial Institute, Columbus, Ohio, is chairman—and a most able one. The committee has been subdivided into four main groups, as follows:

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[1] Read at the meeting of the National Academy of Sciences, Madison, Wisconsin, October 14, 1941.

Ferrous Minerals and Ferro-Alloys Group
Chairman, Gilbert E. Seil, 11 members
Non-Metallic Minerals Group
Chairman, R. P. Heuer, 12 members
Tin Smelting and Reclamation Group
Chairman, F. W. Willard, 6 members
Metals Conservation and Substitution Group
Chairman, Zay Jeffries, 27 members

Problems on which advice is sought originate in OPM and clear through Dr. Leith to Mr. Williams, who makes the specific assignments to the proper group. Studies are made and reports are prepared which are submitted to OPM through Dr. Jewett. In the preparation of reports, help is sought from the most authoritative sources, including individuals, universities, companies, government agencies and bureaus and independent laboratories. It is a pleasure to report that all these groups have cooperated splendidly. They not only have given of their time and energy but have literally opened the archives of their confidential information. I hope that after this terrible international storm has passed there will be given adequate recognition of such service.

Even in a brief statement of this work it should be pointed out how effective is the administration of the committee work by Dr. Jewett. His broad experience in administering technical matters, together with his jealous guardianship of the prerogatives, functions and reputation of the academy, combine to make him the ideal leader of this undertaking.

Some of the committee reports are confidential, some are confidential in part, and others are available for release to interested parties. In the short time allowed for this presentation, only a few high spots can be covered. Being more familiar with the group of which I am chairman, I shall confine my remaining remarks to the work of the Metals Group. Any opinions offered are personal.

Before the complete organization of the Metals Group on March 15, 1941, we had responded to an urgent request from Dr. Leith for a report on the nickel situation. A shortage was not only impending, it was at hand. To date, twenty-three other formal reports have been submitted. Still other reports are being prepared, and no end of problems seems in sight while the emergency lasts.

To gain some idea of the scope of the studies, it may suffice to name the metals on which formal reports have been or are being made. These include nickel, aluminum, magnesium, zinc, chromium, manganese, vanadium, tungsten, molybdenum, copper, tin, antimony, cadmium, lead, cobalt, mercury, iridium, ruthenium, low-alloy structural steels, die castings and steel and cast-iron rolls. Other reports cover specific processes relating to one or more of these metals.

The OPM has specialists on each of the major metals, and our committee cooperates closely with them. The metal pictures change so rapidly that it is necessary to contact these specialists at intervals to avoid working on obsolete phases of the metal problems. By working on the right problems our group helps OPM to a better understanding of the metal requirements for both defense and non-defense and, it is hoped, toward a wiser administration of the metal allocations.

The steps taken last March to ease the nickel shortage, by substitutions, put an added burden on other metals such as chromium, copper, vanadium, etc. A threatened aluminum shortage put a heavier load on copper and zinc, among other metals, and a zinc shortage still further strained the copper supply. A shortage in one metal tends to eat into the stocks of other metals.

Because the steel production is ten times that of all other metals combined, it has taken much of the substitution load and, in the end, it must provide the lion's share of any substantial increase in metal consumption. Now, steel is scarce. A few months ago it seemed as if lead would be plentiful. Unavailability of such metals as copper, zinc and aluminum in sufficient quantities to meet the large non-defense demands has finally resulted in an acute lead shortage.

Thus the story of the past six months has been one of a succession of metal shortages encompassing all the major metals. Of the important defense metals, the supply of molybdenum alone seems to be ample. If the emergency lasts a year or two longer we may look for a shortage of molybdenum.

To make the situation worse, there is the criticism that our stock-piles of essential metals are too low This is true, but the critics are displaying hindsight wisdom and not foresight wisdom such as is found in Dr. Leith's recommendations over the past twenty years. Large stock-piles of strategic metals can not be built up during a world war. The substantial accumulations must be made in peace-time, and authorizations were not adequate until it was too late.

Are things actually as bad as this recitation sounds? Are the shortages real? Is there a ray of light ahead? Surely we do not want to be complacent in the midst of a program calling for every constructive effort; but neither should we become hysterical and lose our sense of proportion. In pointing out some of the brighter facets I shall try to steer the middle course between complacency and hysteria.

First, the shortages are not caused by a lower supply, but by a greatly increased demand. The supplies of the various metals are the greatest in history. Some of the minor metals are available in amounts exceeding twice the normal consumption. Even the steel production is 25 per cent. above that for a reasonably good peace-time year. For the past twelve months the people of the United States have been on a buying spree. Fear of shortage and fear of higher prices both induce buying for future use. The extent of purchases beyond immediate needs is unknown, but, judging from spot checks, this must have been an important factor in the large demand.

When it is realized, however, that this tremendous non-defense use of metals has been concurrent with a major program of building and equipping defense plants, the wonder is not that shortages appeared but that it was possible to provide metals for both activities. As the defense plants are brought into production they will naturally require a larger percentage of the metals, but they will also need a larger percentage of the labor, transportation, electrical energy and many services, thus tending to lessen dislocation resulting from the curtailment of the use of metals in non-defense industries.

Another favorable factor is the quality of the available alloys. The supply of steel-alloying elements, such as nickel, chromium, molybdenum, vanadium and even manganese, is so much greater than normal that a larger percentage of alloy steel is being made than ever before. The enhanced quality of the alloy steels not only makes possible more war material from a given tonnage, but it will make our munitions, all along the line, superior to those of the Axis Powers. So, to the greatest metal quantity of all time we can add the highest average quality of all time.

Now, a few words about the stock-piles. Notwithstanding the late start and the war conditions, stocks of some of the most strategic metals have been accumulated. While these stocks are not nearly as large as desired, they are large enough to cushion any sudden blow, and they have been built under most trying circumstances. Then there is additional comfort on the stock-pile matter. Because we have been for years the greatest industrial nation and have consumed more metal than any other country, we have the greatest of all stores—the metals in use. Except for normal scrap recovery, we have never really drawn from this vast store of metal because we have never had the need to do so. This reservoir can be tapped to almost any extent required by the emergency. For example, if aluminum is desperately needed, 100,000,000 pounds can be drawn off in a few weeks.

Again, we have watched the succession of shortages, but have we learned anything from the experience? Yes, we have learned much. We have found that in many places non-metals, such as plastics, glass, fabric, wood, etc., can be substituted, at least temporarily, for metals. We have seen that, although there are places in which the use of a particular metal is well-nigh indispensable, there are sufficient uses of nearly all the metals in which a wide variety of substitutions of other metals can be made so that all the available metal can be consumed. It is concluded from this that increases in the supply of any metal help the whole situation. The increases can be made where expansion is easiest, cheapest or soonest. This gives assurance that steel expansion will solve many of the shortages in non-ferrous metals, at least during the emergency. This is, indeed, an important conclusion.

Another important factor is over-expectation on the part of the inexperienced. The American people are in the habit of expecting miracles in production. Vast numbers of automobiles, electrical appliances and the like come streaming from the factories without seeming effort or delay. Who thinks about the long periods of research, of trial-and-error, of machine development, of process perfection, of training skilled workers and the many other steps which necessarily preceded the production flow? In the transformation from a peace-time to a defense economy, time-consuming groundwork must also be laid. Part of it has been done, but there is still much of it left to do. Progress eventually must be rated on what comes off the production line, but at the moment it must be judged by the soundness of the preparations. They are sounder than many people think.

Let us elaborate somewhat on this. Special emphasis has been given in the press to the so-called aluminum shortage. During the five years ending with 1939, the average new aluminum consumption in the United States was 256,000,000 pounds annually. Current production is at an annual rate of around 700,000,000 pounds. Obviously, there is no shortage from the standpoint of normal demand. But aluminum is the key to aircraft production, and aircraft production must be still further increased. Therefore, a further expansion in aluminum output will be necessary. Now, one can make some new aluminum, by the thimbleful, in the laboratory in a day's time. But we need it in magnitudes of additional hundreds of millions of pounds. Mining operations must be expanded, new electrical machinery built, great new chemical plants must be erected and equipped, new transportation facilities must be provided, etc., all of which will require time. After all these things are done, production miracles will be performed. And so it is with much of the defense production. The public should understand these things and, understanding, they will have greater confidence in what is being done.

Certain other factors having a bearing on the metal problem should be mentioned:

1. Industry requires more metal during a period of expanding production than after the expansion is completed. The plant stocks must be increased both ahead of and in the production line. Industry has been expanding during the past year or more, and part of the apparent metal shortage has been used to fill those plant "pipe lines."
2. Plant inventories, in raw material, material in process and finished product, are not known. The fear complex should stimulate late rather large inventories, and spot checks tend to confirm this view. In general, capacities and inventories are apt to be underestimated and requirements overestimated.
3. Much equipment, labor and material, such as in the machine-tool industry, are now being extensively used to prepare defense plants for production. When the defense plants are tooled up, these facilities will be liberated, in part, for direct defense production.
4. Plans are under way all along the line to expand the production of the primary metals. The magnitudes range from millions of tons of pig iron and steel, down.

In an effort to appraise all these factors, good and bad, I venture the following opinions:

- a. **There will be ample metal for the greatest defense production of all time.**
- b. **In addition, there will be ample metal to keep up all the essential services, including food, heat, light, transportation, communication, water and gas.**
- c. **There will be a considerable amount of metal for civilian uses ordinarily regarded as non-essential for defense.**
- d. **The kind of metal available for many civilian uses will in many cases represent impairment, but the impaired products will serve well during the emergency.**
- e. **Many of the substitutions will probably have a long-range effect on many products and processes, and, perhaps, even on habits.**

In conclusion, it may be interesting to record impressions gained from many personal contacts during the past six months and covering most phases of the metal industry. In general, the people having the least confidence in our ability to produce are those farthest from the production lines. They are the ones with little information about what is actually going on and little comprehension of what it takes to really produce. On the other hand, the men in the storm-center of production—executives, engineers, scientists, foremen and skilled workmen—have unbounded faith that our defense production will greatly surpass anything the world has ever seen. Assuming that the latter group is the better qualified to pass judgment we are, even now, in great need of unity of purpose and action lest this vast production comes too late.

THE METHOD OF CO-TWIN CONTROL

By Dr. ARNOLD GESELL

YALE UNIVERSITY

GROWTH is an irreversible process. In investigating the growth process one might like to train a child, and then compare him with what he would have been if he had not received the training. This can not be done; there is no way to make the desired comparison. But we may study a pair of identical twins with just such comparisons in mind. We may train one twin (T) experimentally, and reserve the co-twin (C) as a control. C becomes a scientific kind of stand-in-double for T.

In 1927 the writer, in collaboration with Dr. Helen Thompson, undertook a comparative study in which two highly identical twin girls, T and C, were observed from early infancy to determine, first, their developmental correspondence and, secondly, their developmental divergence, as affected by training confined to one twin. A thoroughgoing similarity in physical and behavioral characteristics was amply established by repeated examinations and measurements.[1, 2]

The method of co-twin control had its origin in a stair-climbing and cube-behavior experiment begun when twins T and C were 46 weeks old. Twin T was trained daily in climbing a 5-tread staircase. At 52 weeks she climbed the staircase in 26 seconds. Twin C, at the age of 53 weeks, without any previous training or experience, climbed the same staircase unaided in 45 seconds. As a comparative check, Twin C was then trained for a period of 2 weeks. At the age of 55 weeks she climbed the stairs in 10 seconds. The climbing performance of Twin C at 55 weeks was far superior to that of Twin T at 52 weeks, even though Twin T had been trained 7 weeks earlier and three times longer. At 56 weeks and again at 3 years their performance on the experimental staircase was amazingly alike. These clear-cut quantitative results, sup-

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[1] Arnold Gesell, "The Developmental Psychology of Twins." From A Handbook of Child Psychology. Worcester, Mass.: Clark Univ. Press, 1931. Ed. Carl Murchison, pp. 158–203.

[2] Arnold Gesell and Helen Thompson, *Genet. Psychol. Monog.*, 6: 1–124, 1929.

ported by minutely analyzed cinema records, established certain relationships between learning and maturity.

In a similar way for a period of 6 weeks, Twin T was trained and stimulated in exploitive play with ten one-inch red blocks. Every effort was made to perfect and to elaborate her patterns of cube behavior. Twin C again was reserved as an untrained control. Detailed analysis of cinema records showed a remarkable similarity in the cube behavior of the twins at 46, 52, 63 and 79 weeks of age.

In a later study Strayer[3] used the same co-twin control method to determine the relative efficacy of early and deferred vocabulary training. The twins were separated and kept under continuous observation. Twin T was trained from her 84th to 89th week. Twin C was trained for 4 weeks beginning with the 89th week. C reached a higher level of language performance after 28 days than did T after 35 days of training. T was only slightly superior at 93 weeks; three months later the difference was negligible.

When the twins were 4½ years old, Hilgard[4] used the co-twin control method to compare the effects of early and delayed practice in motor and memory performances—ring tossing, walking board skill, digit and object memory and paper cutting. Three months and also six months after practice, the performances of the twins on all tests were as similar to each other as at the beginning of the experiment.

Through an exceptionally fortunate convergence of circumstances it has been possible to follow the development of these self-same twins for 14 years. Numerous observations and coincident comparisons were made at advancing ages. Simultaneous observation with segregation of the twins was accomplished by a duplex non-communicating suite, equipped at the end with a single one-way-vision window. The findings of these studies and of the several co-twin control experiments have been coordinated in a recent monograph which reviews the life careers of the twins for the whole period from early infancy to adolescence.[5] Both physical and behavioral characteristics were considered as follows: (1) *Anthropometry:* height and weight, palm prints, dentition, hair and eye color, hair histology, vision, hearing, health, eating and sleeping, puberty, homeostasis. (2) *Motor Behavior:* postural demeanors, laterality, locomotion, fine coordination. (3) *Adaptive Behavior:* mental growth rates, block construction, play behavior, drawing, school achievement. (4) *Language Behavior:* infant vocalizations, enunciation, vocabulary, conversation. (5) *Personal-Social Behavior:* adjustments to home and school, inter-twin dominance, humor, fantasy, personality traits.

This sequential study represents a biogenetic application of the combined methods of co-twin control and coincident comparison, to determine the stability of behavior resemblances and differences. The long reach of the data, with numerous nodes for cross comparison, made it possible to analyze such factors as ontogenetic timing, physiological tempo, attentional traits and the durability of individualities of behavior and personality. So far as Twins T and C are concerned many of our conclusions seem firmly grounded.

Some of the conclusions may be safely generalized. But the method of co-twin control has its limitations. A twin is not an absolute unit of measurement; and we must start all over again with the next pair of twins. In this sense, twins are uncalibrated and fall outside the calculus of biometrics. Nevertheless, when one reflects that even physics with its beautiful mathematical precisions is never on absolutely absolute ground, we may accord a certain pragmatic value to a method which applies a norm that equals in complexity the phenomena to which the norm is applied.

The distinctive feature of the method of co-twin control is its utilization of an organismic norm. Such a norm has certain advantages over a purely statistical criterion. Statistical norms and devices can never be organismic because they are either heterogeneously unselected or homogeneously selective and must therefore remain analytic and partial in application. But a control co-twin is by definition highly identical with the individual under investigation. He is in fact the sum of a statistically numerous multitude of forces. He is an embodied quantity who with respect to any distinguishable trait is more or less than the investigated individual.

A control co-twin is a synthetic standard of comparison with a highly equivalent prenatal and postnatal life career, except for divergences which are experimentally created or naturalistically observed. When one contemplates the almost infinite number of variables which enter into the shaping of any life career, it must be granted that an "identical" co-twin who brings these variables into finite and manageable range is indeed an extraordinarily powerful statistic in his own integral person. His individuality is unique, but by definition it is almost a replica of the individuality which is being assayed. The patterns of twin and co-twin do not exactly superimpose. But by matching we measure. We expose areas and directions of discrepancy. The almost complete identity of the datum and the measuring device gives augmented significance to all discrepancies which can be defined and accounted for.[6]

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[3] L. C. Strayer, *Genet. Psychol. Monog.*, 8: 209–319, 1930.

[4] J. R. Hilgard, *Genet. Psychol. Monog.*, 14: 493–667, 1933.

[5] Arnold Gesell and Helen Thompson, *Genet. Psychol. Monog.*, 24: 3–121, 1941.

[6] Arnold Gesell, SCIENCE, 88: 2280, 225–230, 1938.

With such a rationale it is evident that the method of co-twin control requires that a thorough parity and identity be established by careful measurements *prior* to the period of comparative observation and experiment. If there are any significant antecedent discrepancies they should be recorded and taken into account in subsequent comparisons. H. H. Newman in an interesting chapter on the psychology of twins has called attention to the importance of this aspect of the method of co-twin control. Referring to the New York twins, Johnny and Jimmie, he writes:

> One of these twins, we don't remember which and it doesn't matter, was trained to be a little gentleman and the other allowed to grow up like Topsy. As time went on they became very different in motor skills and in social behavior. This would have been an excellent case for testing the effects of different environment and training on two individuals alike in their heredity, except for one defect in the setup. Johnny and Jimmie turned out to be a pair of two-egg twins! So the co-twin control feature was entirely lacking and therefore the experiment was meaningless. . . .[7]

Newman properly points out that unless one-egg twins are used it is impossible to distinguish hereditary from environmental effects. Galton had the same thought in mind, when in 1875 he wrote his famous paper entitled "The History of Twins as a Criterion of the Relative Powers of Nature and Nurture."[8]

The method of co-twin control presupposes one-egg twins of thoroughgoing similarity, with environmental factors held constant, except for precisely defined or experimentally imposed differentiations.

The method of co-twin control therefore is essentially a clinical method, designed for the intensive study of monozygotic pairs (to say nothing of monozygotic triplets, quads or quints!). It can attain statistical status, in the ordinary sense of that term, only when a sufficiently large number of comparable co-twin control studies are accumulated. Such a statistical extension of the method was advocated in 1930 by Blakeslee and Banker in a paper entitled "Identical Twins as Biological Controls in Educational and Other Human Problems."[9] The authors suggested an endowed school for one-egg twins instructed by monozygotic twin teachers! Just at this time, Russia organized an institute for twin research in connection with the Maxim Gorky Medico-Biological Institute of Moscow. The method of co-twin control was used on a systematic scale for a large variety of studies. A score of scientists pooled their resources and in 1935 some 800 pairs of twins, mostly children, had been investigated. This striking enterprise resulted in significant studies, but was terminated about three years later.[10, 11]

Although these large-scale investigations are impressive, it should be pointed out that the method is not essentially enhanced by multiplication. A large number of cases may confirm trends and define new problems; but numbers will not in themselves be productive. The method is clinical; it is productive in the single instance. It depends heavily upon the ingenuity and insight of the experimenter; and it is capable of far-reaching adaptations. The areas of possible application have scarcely been scratched. The method has numerous potentialities in the field of medicine, which already boasts a vast literature on twins and twinning phenomena. The medical literature, however, is largely documentary, rather than experimental. Co-twin control has many unrealized applications in clinical-physiology, pharmacology and experimental therapeutics.[12]

The method of co-twin control is peculiarly suited to the analytic study of the processes of child development and the genetic factors of life-career. If the instincts of an organism were only tinted pink and the habits robin egg blue, as Lloyd Morgan whimsically wished, then we might better grasp the relationships of nature and nurture, of endowment and environment. This differential stain has not been forthcoming; but with the aid of co-twin control studies we may glimpse the interrelations of learning and growth, the effects of specific training, the influence of attitudes and emotional patterns. The method may be fruitfully used to explore these intricate problems which are so resistant to absolute biometric approach. The method preserves the togetherness of the individual and affords more insight into the total integrated economy of performance and development. Critically used it is to a considerable degree self-corrective.

When so used we come, in the end, to a better understanding not only of one individual but of two, for one reciprocally elucidates the other. When the comparisons are made successively over a long ontogenetic range, this comparative method also illumines the processes of growth. Differences and correspondences in timing establish points to reckon by. And even though the method is one of dead reckoning and lacks the elegance of classic mensuration, it may bring a mariner shrouded in shifting fogs to the vicinity of a port.

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[7] H. H. Newman, "Multiple Human Births. Twins, Triplets, Quadruplets and Quintuplets." New York: Doubleday Doran. xi + 214 pp., 1940.

[8] Francis Galton, *Jour. of the Anthropological Institute*, 5: 391–406, 1876.

[9] A. F. Blakeslee and H. J. Banker, *Proceedings of the American Philosophical Society*, Vol. 69, 1930.

[10] S. G. Levit, *Character and Personality*, 3: 188–193, 1935.

[11] A. R. Luria, *ibid.*, 5: 35–47, 1936.

[12] Arnold Gesell (with Eugene Blake), *Archives of Ophthalmology*, 15: 6, 1050–1071, 1936.

OBITUARY

KARL M. WIEGAND

Dr. Karl M. Wiegand, for many years head of the department of botany at Cornell University and professor emeritus of botany since August, 1941, died at Ithaca, N. Y., on Thursday, April 12. Burial was at Truxton, New York. He is survived by his wife and one daughter.

Professor Wiegand was born in the village of Truxton, N. Y., on June 2, 1873. This was his home until he entered Cornell University. Influenced no doubt by his father, who was a pharmacist of the scholarly type, he developed an interest in his natural surroundings. As a boy of fifteen, by working on difficult plant groups, he was already demonstrating interest and ability in problems in taxonomy. In an Atlas of Cortland County owned by his family appear notations of his early searches and expeditions to the various valleys, hills and swamps of that beautiful region.

Truxton being a small village and only about 30 miles from Ithaca by a branch railroad, he went to Ithaca High School to prepare himself for entrance to Cornell, with the intention of specializing in pharmacy. Just previous to his entrance into the university the course in pharmacy was abolished. Nevertheless, he entered Cornell and here began his formal education in botany. This he selected as his major subject, and in accordance with the requirements for graduation submitted a thesis. The subject of this thesis was seed anatomy, and the quality of the investigation was of such a character that it gained for him election to Sigma Xi. He graduated from Cornell with the B.S. degree in 1894.

Following his graduation he became assistant in the department of botany and began graduate studies. His early interests were diverse and included physiology, anatomy and morphology, but he continued his special interest in taxonomy. Despite his early work in taxonomy and his special interest in this field, his thesis was concerned with frost injury of buds and his purpose at this time was to specialize in plant physiology. The Ph.D. degree was granted to him in 1898 and the following year he was promoted to the rank of instructor. It was not until 1900 in the "Announcement of Courses" that his name appears associated with instruction in taxonomy.

In 1907 Dr. Wiegand accepted a position at Wellesley College as associate professor of botany. Here he taught elementary botany and taxonomy until 1913 and during this period made taxonomy his major field of work.

Largely through the efforts of Dr. Liberty Hyde Bailey, then dean of the College of Agriculture at Cornell, a new Department of Botany was organized in the College of Agriculture in 1913. Dr. Wiegand was made head of this new department, which within a few years absorbed the Department of Botany of the College of Arts and Sciences.

For a period of twenty-eight years, until his retirement in August, 1941, he wisely guided the department and was largely responsible for bringing the department to its high reputation. At Cornell he was free to follow his chosen field and confined his research and teaching to taxonomy. Despite the pressure of administrative duties he found time to develop from very little a herbarium of about 250,000 specimens. This alone would have been an achievement, but in addition he gave liberally of his time to the identification of plants for botanists from all parts of the country. His enthusiasm for the subject of taxonomy was contagious. Countless students were inspired by him to become interested in plants and to appreciate the value of taxonomic studies in their practical and cultural aspects. When it was realized a little over a year ago that Dr. Wiegand was to retire, his courses in taxonomy became filled to capacity. These students wanted to be taught by the master.

His desire to do research was manifest early in life and continued to the end. Despite the multitude of other duties associated with his position he found time for research. He published more than one hundred papers. His intensive field studies of the plants of the Cayuga Lake region resulted ultimately in the publication of the "Cayuga Lake Flora," prepared in association with Dr. A. J. Eames. The excellence of this work has resulted in the general acceptance of this publication as the model of its kind. He made a notable contribution to horticulture by preparing for Bailey's Standard Cyclopedia the extensive and technical "Synopsis of the Vegetable Kingdom" and by his assistance in the preparation of the Introductory Key. He was recognized as one of the leading taxonomists of the world.

Dr. Wiegand was vice-president of Section G of the American Association for the Advancement of Science in 1933 and in 1939 he was president of the Botanical Society of America. For a period of eleven years following the World War, he directed the Summer School in Biology at Cornell, which attracted many students.

Dr. Wiegand was a very modest man who loved his fellow men. He was unselfish to a degree seldom found in men. He viewed his research problems objectively and was always ready to forsake his own views when convinced of the validity of concepts proposed by others. His quiet cheerfulness, his high ideals and his thoughtful consideration of others endeared him to his students, to his colleagues and to all who were associated with him.

LEWIS KNUDSON

CORNELL UNIVERSITY

DEATHS AND MEMORIALS

VERNON BAILEY, from 1887 until his retirement in 1933 chief field naturalist of the Biological Survey, U. S. Department of Agriculture, died on April 20 in his seventy-eighth year.

DR. EDWARD ROYAL WARREN, from 1909 to 1918 director of the Museum of Colorado College, died on April 20, at the age of eighty-one years.

DR. F. M. PAGAN, chairman of the department of biology of the University of Puerto Rico, who had been serving as exchange professor of botany at Duke University, died on April 15.

DR. GUSTAVE WHYTE THOMPSON, chief chemist and director of the National Lead Company, retired, died, as the result of an automobile accident, on April 22. He was seventy-six years old.

THE death on March 13, at the age of sixty-five years, is announced of Captain Guy Dollman, assistant keeper of zoology in the British Museum (Natural History).

A SERIES of lectures has been established at Columbia University as a memorial to Dr. Frederick J. E. Woodbridge, Johnsonian professor of philosophy, from 1912 to 1929 dean of the Graduate Faculties, who died on June 1, 1940. Professor Wilmon H. Sheldon, of the department of philosophy of Yale University, has been appointed the first lecturer.

SCIENTIFIC EVENTS

PROTECTION AGAINST FOREST FIRES

W. S. ROSENCRANS, of Los Angeles, president of the American Forestry Association, has submitted to President Roosevelt a resolution passed by the board of directors of the association at a meeting recently held in Washington.

The resolution calls upon all conservation agencies and forest users—federal, state and private—to "dedicate their undivided efforts to the doing of those things that are clearly of first importance within their field in promoting the common cause of victory." In the forest field the association holds that three lines of action now claim and should have undisputed priority. They are:

> Protection of forest and related resources and of war industries, including power, water and transportation lines essential to their operation, against the impending danger of forest fires. This is an immediately critical threat to our war efforts: first, because in addition to normal forest fire hazards, sabotage by our enemies of our production of wood, our supply lines, and operation of war industries through widespread setting of forest fires by aerial bombing and ground incendiarism is not only possible but probable this summer; and, second, because adequate preparedness against such a contingency is not now assured. The danger is particularly acute on the Pacific Coast where vital war industries are concentrated and from which our prosecution of the war in the Pacific is based.
>
> Maintenance of continuous production of wood and other forest products essential to the prosecution of the war. Most of the war industries, the training of our armed forces and the shipment of supplies and equipment to the fighting fronts of the United Nations is dependent in large part upon an uninterrupted production and delivery of wood in raw and fabricated forms.
>
> Accelerated research in the use and production of cellulose, plywood, lumber and other forest products related to war needs. Such research will not only promote the conservation of our forest resources but it will strengthen and speed our war effort by providing improved equipment and by helping to overcome shortages in other materials that are now or may in the future impede war action.

"We believe," the resolution concludes, "that the accomplishment of these objectives is vital to the winning of the war and that they should have the united and supreme effort of all individuals and groups in the forest field. To this end we urge that highly controversial issues, such as federal regulation of privately owned timberlands, be set aside until the war is won, without prejudice as to their merit or desirability when normal conditions of American life are reestablished."

EXPEDITION OF THE NEW YORK ZOOLOGICAL SOCIETY

The New York Times has received word from Caripito, Venezuela, to the effect that Dr. William Beebe's forty-second expedition was ready on March 23 to start explorations into the dense Venezuelan jungle near the settlement.

The expedition, which is being conducted under the auspices of the Department of Tropical Research of the New York Zoological Society, has headquarters on the edge of the jungle in the modern camp of the Standard Oil Company of Venezuela. Electricity, baths, good food, talking pictures, swimming pool and golf course and a well-equipped laboratory are at the disposal of the unit, all less than twenty minutes away from the wilderness that Mr. Beebe has studied in his eight years in British Guiana.

The expedition has made preparatory incursions into the jungle and is getting its implements and test-tubes in order while waiting for the rainy season. One of the mysteries of the jungle is where the birds, animals and reptiles disappear during the hot, dry months of winter. Nevertheless, it is reported that the party has seen howling monkeys, tapirs, tigers, ferocious wild boars, deadly bushmaster and coral snakes, anteaters and sloths.

Dr. Beebe is chiefly interested in studying the evolution of animals in the Venezuelan jungle, which are similar to the species he studied in British Guiana. The expedition, financed by the Simon Guggenheim Foundation, includes Miss Jocelyn Crane, research zoologist; Henry Fleming, entomologist; George Swanson, artist, and Mary Vander Pyl, field associate. Miss Vander Pyl has not yet joined the staff, but will do so shortly. The expedition will remain in Caripito for six months. Part of the time will be spent on a houseboat on the San Juan River, a haven of strange bird species found in no other part of the world.

THE BIOLOGICAL RESEARCH INSTITUTE OF THE ZOOLOGICAL SOCIETY OF SAN DIEGO

THE Zoological Society of San Diego announces the renewal of two research fellowships available to advanced graduate students of either sex for research work at the Biological Research Institute in the fields of bacteriology, parasitology, veterinary medicine, food preservation and other problems related to national defense. The stipend of each fellowship is $1,000 per annum.

The Zoological Hospital and Research Institute is supported by public appropriations and endowed funds, and is devoted to problems concerned with the health and normal life of animals, in and out of captivity, and to other phases of biological research. It is conducted in connection with the San Diego Zoological Gardens which houses 3,000 animals, including 175 species of mammals, 500 species of birds and 150 species of reptiles.

Research facilities include a two-story building with individual laboratory and office rooms. Refrigeration, incubation, x-ray and microphotographic apparatus, microtomes, microscopes, etc., are available in the building. An extensive outdoor animal isolation yard houses all new animals and research material. New animals are continually arriving from different parts of the world. There is a wealth of material for pathological, bacteriological, parasitological and anatomical study from the zoological gardens and other cooperating agencies.

The Biological Research Institute is not directly affiliated with any university, but qualified students may make arrangements to work for an advanced degree under the jurisdiction of cooperating universities. Only the thesis or dissertation requirements or parts thereof can be fulfilled at the Biological Research Institute. Preference will be given to advanced graduate students. Information in regard to these fellowships will be sent on request. Applications should be addressed before May 15 to Dr. Frank D. McKenney, Biological Research Institute, Balboa Park, San Diego, California.

THE COLD SPRING HARBOR SYMPOSIUM ON QUANTITATIVE BIOLOGY

THE tenth annual symposium at the Cold Spring Harbor Biological Laboratory will be held from June 10 to June 20. The subject to be considered this year is "The Relation of Hormones to Development." Topics for presentation and discussion will include: hormones of micro-organisms; hormone-controlled processes in insect development; analysis of eye-color differentiation in Drosophila; relation of organizers to development; natural influences and formative effects induced with hormone-like substances in higher plants; chemistry of hormones; relation of vitamins to hormones; hormones and photoperiodism; pituitary hormones affecting development in higher animals; the gonadotrophic and thyrotrophic hormones; hormonal control of embryo and seedling; endocrine factors in atypical growths; induction and prevention of abdominal fibroids by steroid hormones; formative influence of carcinogenic substances; hormonal regulation of development in lower vertebrates; hormonal control of differentiation in birds; hormones and the growth of the parts of the urinogenital apparatus in mammalian embryos; hormones as dedifferentiating agents; the role of hormones in senescence; hormones and overgrowths.

Invitation papers on these topics will be presented by twenty-two investigators from the United States, Canada and South America. Copies of the program will be sent on request. All papers and prepared discussions will subsequently be published as Volume X of the Cold Spring Harbor Symposia on Quantitative Biology.

All who are interested may attend the symposium and take part in the informal discussion of papers without further invitation. In addition, the Biological Laboratory offers its facilities for biological and biophysical research to participants in the symposium and to other investigators throughout the summer.

THE AMERICAN ASSOCIATION OF CEREAL CHEMISTS

THE annual meeting of the American Association of Cereal Chemists will be held at the Edgewater Beach Hotel, Chicago, from May 18 to 21. The sessions have been arranged under the following subjects: Agronomy and milling technology; statistical clinic;

cake, biscuit and cracker technology; laboratory baking methods; malting and brewing; protein symposium; bread baking technology; general analytical methods; symposium on flour and bread nutritional supplements. While it is not possible to give all the details of the program, attention should be drawn to the opportunity for cereal chemists to discuss their statistical problems in the statistical clinic, which consists of a joint session of the association with the Biometric Section of the American Statistical Association.

At the opening session, Dr. T. R. Hogness, of the University of Chicago, will discuss respiratory enzymes and their relationship to some of the vitamins; Dr. C. H. Goulden, of the Dominion Rust Research Laboratory of Winnipeg, Manitoba, will present a paper entitled "Experimental Design for Cereal Chemists," and Dr. R. M. Hixon, of Iowa State College, will give an address on "Starch."

At one of the general sessions, Dr. R. A. Gortner, of the University of Minnesota, will give the Osborne Medal Award address. It will be entitled "The Plant Proteins."

Among the speakers at a general session immediately preceding the symposium will be Dr. C. A. Elvehjem, of the University of Wisconsin. He will speak on "The Water Soluble Vitamins"; Dr. R. R. Williams, of the Bell Telephone Laboratories of New York, will discuss the "Progress of Flour and Bread Enrichment"; Mrs. Clara Gebhard Snyder, of the Wheat Flour Institute, will discuss "Enriched Flour as the Consumer Sees It."

In all, sixty-four papers and addresses have been listed, covering a wide range of subjects.

SCIENTIFIC NOTES AND NEWS

Dr. Edwin Grant Conklin, professor of biology emeritus of Princeton University, was elected on April 24 president of the American Philosophical Society to succeed the Honorable Roland S. Morris. Dr. Conklin has been vice-president of the society since 1932 and executive officer since 1936.

On the occasion of the celebration in Boston, on April 17, of the one hundred fiftieth anniversary of the founding of the Massachusetts Society for Promoting Agriculture, the medal of the society was awarded for his botanical services to Dr. Elmer D. Merrill, director of the Arnold Arboretum and administrator of Botanical Collections, Harvard University.

Dr. Henry Butler Allen, director of the Franklin Institute, Philadelphia, has been awarded a George A. Hoadley certificate to mark the completion of a quarter of a century of active service with the institute.

The William Osler Medal of the American Association of the History of Medicine has been awarded to John T. Barrett, of the School of Medicine of Boston University. The presentation will take place at the annual meeting, which will be held in Atlantic City on May 3, 4 and 5.

Among those on whom honorary degrees were conferred by the Jewish Theological Seminary of New York, at exercises in commemoration of the one thousandth anniversary of Saadia Gaon, the Hebrew philosopher, was Dr. Arthur H. Compton, Charles H. Swift distinguished service professor of physics at the University of Chicago.

Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution, and Dr. Edward A. Chapin, curator of the Division of Insects of the U. S. National Museum, have been elected corresponding members of the Academia Columbiana de Ciencias Exactas, Fisico-Quimicas y Naturales.

Dr. J. B. Tyrrell, consulting mining engineer of Toronto, has been elected a senior fellow of the Geological Society of London. Dr. Tyrrell has been a member of the society for sixty years.

Officers elected at the annual meeting of the American Society for Pharmacology and Experimental Therapeutics are: *President,* E. K. Marshall, Jr., the Johns Hopkins University; *Vice-president,* Carl A. Dragstedt, Northwestern University; *Secretary,* Raymond N. Bieter, University of Minnesota; *Treasurer,* Erwin E. Nelson, Tulane University; *Councillors,* McKeen Cattell, Cornell University; Ralph G. Smith, University of Michigan.

Professor Gordon Allport, chairman of the department of psychology of Harvard University, was elected president of the Eastern Psychological Association, at its recent meeting at Brown University. Other officers elected were: Dr. Theodora M. Abel, Thiells, N. Y., *Secretary;* Dr. Kurt Goldstein, Tufts Medical School, *Member of the Program Committee;* and Professor Gardner Murphy, College of the City of New York, and Dr. Otto Klineberg, Columbia University, *Directors.*

At the recent annual meeting of the Supervisory Board of the American Year Book, an organization sponsored by forty-five learned societies, Professor Marston Taylor Bogert, of Columbia University, the representative of the American Chemical Society, was elected to the presidency. Rear Admiral George H. Rock (C.C.), U.S.N. retired, representing the Society of Naval Architects and Marine Engineers, was elected to the vice-presidency.

At the meeting of the American Institute of Nutrition in Boston on April 1, the following officers for the coming year were elected: *President,* L. A. Maynard; *Vice-president,* H. B. Lewis; *Secretary,* A. H. Smith; *Treasurer,* W. H. Sebrell, Jr.; *Councillor,* T. H. Jukes.

Dr. Walter Bradford Cannon, George Higginson professor of physiology at Harvard University, and Dr. Reginald Aldworth Daly, Sturgis-Hooper professor of geology, will retire with the title emeritus on September 1.

Chancellor William P. Graham, professor of electrical engineering and dean of the College of Applied Science of Syracuse University and since 1937 chancellor of the university, having reached the age of seventy years, has presented his resignation to the board of trustees to take effect within a year. Dr. Graham accepted the office of chancellor in 1937 for a period of one year or until his successor should be appointed.

Dr. John H. Mueller, associate professor of bacteriology and immunology in the Harvard Medical School, Boston, has been named professor of bacteriology and immunology, the appointment to be effective on July 1. He will also take charge of the department at the Medical School and at the School of Hygiene and Public Health. Dr. Fuller Albright, medicine; Dr. Allan M. Butler, pediatrics, and Dr. Hiram H. Merritt, neurology, have been promoted to associate professorships. Dr. Fredrick J. Stare, who graduated at the University of Chicago School of Medicine in 1941, has been appointed assistant professor of nutrition.

Museum News reports that William L. Corbin, librarian of the Smithsonian Institution and custodian of the Smithsonian deposit in the Library of Congress since 1924, retired in January. He is succeeded by Mrs. Austin H. Clark, assistant librarian in the U. S. National Museum.

As has been already announced in Science, the decision of the council of the Zoological Society, London, that the post of secretary be temporarily suspended, has been challenged by an informal committee of fellows of the society. The committee states that it "disapproves of the action of the council in attempting to terminate Dr. Julian Huxley's appointment as secretary to the society during his absence abroad with the council's permission."

Dr. M. F. Morgan, head of the department of soils in the Connecticut Agricultural Experiment Station at New Haven, has been called to active duty as Lieutenant Colonel of Infantry in the United States Army. Dr. Herbert A. Lunt will be acting head of the department of soils during Dr. Morgan's absence. Edward Rubins, of Rutgers University, has been appointed research assistant in soils.

Dr. Frank E. Egler, assistant professor, New York State College of Forestry, Syracuse, N. Y., has leave of absence for the present semester in order to carry on ecologic investigations in British Honduras and Guatemala. He left New Orleans on February 14 and will return in September.

The past and future of trans-ocean communication were reviewed before the Institution of Electrical Engineers, London, on April 23 in a paper prepared for the thirty-third Kelvin Lecture by Dr. Oliver E. Buckley, president of the Bell Telephone Laboratories, New York. Since Dr. Buckley could not attend in person, he had recorded a brief sound-picture. After he had appeared on the screen before the audience in London, his paper was read by Sir Stanley Angwin, vice-president of the institution.

The second Robert J. Terry Lecture of the Washington University Medical Alumni Foundation was delivered on April 22 by Dr. George Bernays Wislocki, Parkman professor of anatomy at the Harvard Medical School. His subject was "The Primate Placenta, with Particular Reference to the Trophoblast."

Dr. Dennis R. Hoagland, head of the division of plant nutrition at the University of California College of Agriculture, delivered, during April, at the School of Biology of Harvard University, under the auspices of the Prather Foundation, a series of five lectures on the "Inorganic Nutrition of Plants."

The fifty-second annual meeting of the Ohio Academy of Science was held on April 16, 17 and 18 under the presidency of Dr. Eugene Van Cleef, professor of geography at the Ohio State University. His presidential address was entitled "The City of Tomorrow."

The Louisiana and New Orleans Academies of Sciences are holding a joint meeting in New Orleans, at the St. Charles Hotel, on May 1 and 2. The Junior Academies of the two organizations will meet at the same time with exhibits on Friday and papers on Saturday. Dr. Carl G. Hartman, of the department of zoology of the University of Illinois, is the guest speaker at the banquet.

A new series of short-wave broadcasts was inaugurated under the auspices of the American Philosophical Society on April 24 over the non-commercial short-wave radio station WRUL. A series of addresses was arranged, each by an authority in his special field. It is planned that the significance of American thought and achievement in the present crisis in our civilization form the general background of the series. Dr. Robert A. Millikan, chairman of the executive council of the California Institute of Technology, gave the first thirty-minute program. The proceedings were opened by the Honorable Roland S. Morris, retiring president of the society. Dr. Edwin G. Conklin, the newly elected president, was the principal speaker. Walter Lemmon, president of WRUL, and Sir Angus Fletcher, consultant on programs addressed to the British Empire, also spoke.

THE Brush Foundation of the Western Reserve University School of Medicine has received from the General Education Board of the Rockefeller Foundation a supplementary grant of $15,000 for one year to be used in completing its study of the growth and development of adolescent children. This study was begun in 1935 by the late Dr. T. Wingate Todd and has been continued by Dr. William Walter Greulich, director of the Brush Foundation and professor of physical anthropology and anatomy in the School of Medicine.

BY the will of Charles H. Hastings, the major part of his estate is left, in memory of his father, Charles Cook Hastings, to establish a foundation for the prevention and treatment of tuberculosis. The estate is reported to amount to more than two million dollars. After payment of annuities to friends and servants, the entire estate will go to the foundation. It is provided that the Charles Cook Hastings Home be built either on "several large parcels of property near Beaumont, Calif.; Banning, Calif.," or on the Mesa Alta Ranch, near Pasadena, which he owned. The will instructs the executors to build a sanatorium to be conducted and maintained on a strictly charitable basis.

WILLIAM R. WARNER AND CO., INC., of New York, has given funds for a two-year fellowship for study in the department of radiology at the Long Island Medical School, Brooklyn, N. Y. Grants have also been made to the New York University Medical School for the study of the conjugation of the sulfonamide drugs, to be carried out in the Pneumonia Service of the Harlem Hospital; to Northwestern University Medical School, Chicago, to investigate the possibilities of detoxifying therapeutic agents used in the practice of dermatology; and to the Washingtonian Hospital, Boston, for the study of alcoholism. This study will involve the blood chemistry and psychometric findings of cases while under the influence of alcohol and during recovery.

THE facilities of Iowa State College have been accepted by the United States Navy for the establishment of a Naval Training School for Electricians. Beginning about June 1, eight hundred men at a time will receive sixteen weeks of training; the continuous program will probably last throughout the war. The departments of electrical engineering, mechanical engineering, mathematics and physics will provide instruction.

DISCUSSION

THE PALEONTOLOGICAL COLLECTIONS AT THE UNIVERSITY OF CINCINNATI

FOR better than forty years the University of Cincinnati has been bringing together a representative collection of the world-famous Cincinnatian (Ordovician) fossils. There was a time when it was all too true that the Cincinnati community slept while her unrivalled paleontologic heritage was scattered over the world and when no satisfactory collection existed or was available in the city. This was the state of affairs as late as 1902, when J. M. Nickles, in his "Geology of Cincinnati," quite rightly deplored the situation. Happily, most of the early collections, the basis for much of the early descriptive work, remained in the country, at least, and are preserved for all time in such institutions as the U. S. National Museum, the Museum of Comparative Zoology, the American Museum of Natural History, the Walker Museum and other great centers of geological research. Now, after more than four decades of concerted effort, a research collection that is thoroughly representative has been amassed and safely preserved in Cincinnati's municipal University Museum.

With the acquisition by gift in the fall of 1941 of the collection of E. H. Vaupel, the last of the old-time private collections in the Cincinnati area finds a safe harbor. Mr. Vaupel is the last local survivor of that "age of giants" in the last century when the wonders of Cincinnati's hills were first being made known to science. His enthusiasm for fossils grew from his early association with S. A. Miller, Charles Dury, Charles Schlemmer, Charles Faber, August Foerste and Drs. George Austin and George Twitchell, all of whom stayed their days out on the Cincinnati uplift. His first inspiration for "dry-dredging" came from his youthful acquaintance with Edward Ulrich, of Covington and now of Washington, and Professor Charles Schuchert, another Cincinnati lad, now emeritus at Yale University. Beginning his cabinet in the closing days of the "golden era," Vaupel's collection contained few types of original descriptions of the Cincinnati fauna, but has a very real compensatory asset in having been made after stratigraphic details and zonation were worked out. It comes in very large part from abandoned quarries and worked-out localities—many topotypic, and apparently lost forever to science. With a thorough knowledge of the usual run of Cincinnatian fossils, his chief interest was to discover new extensions of range, new localities and new forms. Herein lies the great scientific worth of the Vaupel collection. The inventory and cataloguing of Mr. Vaupel's collection proceeds apace, and within the year most of the thousands of specimens will be allocated to their proper niches in the fireproofed permanent research collections of the University of Cincinnati.

Fortunately for Cincinnati geologists, not all the historically famous old collections left their home area, as for a while it seemed likely they would. In 1889 the University of Cincinnati received the U. P. James collection by bequest. Although the bulk of the James types had gone elsewhere, this was the nucleus of type materials and research collections that have been added to with the years. The residue of the S. A. Miller collection was purchased from his heirs in 1917, some twenty years after Miller's death. Although much of the type material had been sold to other institutions by that time, some 2,000 types were discovered by painstaking comparisons when the collection was inventoried for the 1936 catalogue of the University of Cincinnati Museum types. Not all these type materials pertain to the Cincinnatian, however. Thousands of research specimens were added by the gift of the Charles Schlemmer collection, Dr. Twitchell's specialized collection of specimens and thin-sections of bryozoans and stromatoporids, an early collection of bryozoans and micro-fossils made by Mr. Vaupel, and the great general Cincinnatian collection that Charles Faber amassed in his later years. Faber's collection went to the university with an endowment sufficient to insure a permanent research curator of paleontology and a generous publication fund for paleontology at the University Museum.

Early in 1942 arrangements were completed by which the very extensive fossil collection of the Cincinnati Society of Natural History will be on deposit at the University Museum, where it will be thoroughly restudied, catalogued and made available for researchers. For better than three quarters of a century this collection has been growing; its quality is considerably better than one might anticipate from the statement made by Nickles in 1902 that "the paleontological collection of the Cincinnati Society of Natural History consists mainly of odds and ends which have come to it piecemeal." Those "odds and ends" are a large number of old-time local collections and much foreign material acquired years ago by exchange. It apparently embraces a good many type specimens which have been in essence lost to science until now. The collection contains as well a splendid array of rare and undescribed specimens that were added "piecemeal." The society is to be congratulated for having kept its collection intact through the years, even though not sponsoring paleontological research or having facilities for exhibiting extensive fossil materials. Cincinnatians are especially grateful to the society for keeping the collection permanently in the city, and particularly for making it available at this time, which is one of great recrudescence of local paleontologic interest.

In addition to these invaluable older collections which have come to the University of Cincinnati by gift and purchase, the faculty and students of the Department of Geology and Geography have been for many years assiduously collecting fossils and data from the disappearing old-time sites in the Cincinnati hills, the while keeping pace with new exposures and excavations. An enormous aggregate of research material is the result. Thus generosity and industry have in part redeemed the loss of many early collections, and a truly rich representation of Cincinnatian paleontology and the necessary comparative materials are now preserved in Cincinnati. There they await the long years of research ahead before the store of knowledge is exhausted and the full story of the Cincinnatian epoch told.

KENNETH E. CASTER
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ORIGIN OF THE TERM "EUTHENICS"

In my article on "The Term 'Euthenics,'"[1] I discussed the possibility of a wider adoption of the term. Since then question as to its origin has been raised, and I have asked Dr. C. B. Davenport, who was one of the first American advocates of its use, to make a statement on that subject. He writes:

> You may recall that in June, 1910, Mrs. E. H. Harriman announced her plan to start the Eugenics Record Office and the newspapers made quite a good deal of it at the time. Mrs. Ellen H. Richards soon thereafter prepared a small book entitled "Euthenics" (with a subtitle, "The Science of Controllable Environment") and some time later a course in euthenics was given at Vassar. So far as I know Mrs. Richards was the first to use this term.

Mrs. Richards pointed out that the concept was well defined by the Greeks and appeared in two forms:

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[1] SCIENCE, 94: 2450, 561–562.

eutheneo (Demosthenes, Aristotle, Herodotus) and *euthenia* (Herodotus).

CARL E. SEASHORE

NORWEGIAN MEMBERS OF THE ROYAL SOCIETY OF GÖTEBORG

IT may interest readers of SCIENCE to hear that a petition subscribed by practically all members of the R. Society of Göteborg resident in the city has been presented to the Swedish minister for foreign affairs asking him to intervene in favor of three Norwegian members of the R. Society who have been illegally imprisoned and subjected to severe treatment by the present authorities in Norway. The following is a translation from the Swedish original, which carried the signatures of fifty-two members:

> To his Excellency the Minister for Foreign Affairs:
>
> Three foreign members of the Royal Society of Science and Letters of Göteborg, *viz.*, the principal of the University of Oslo, Didrik Arup Seip, and the professors of the same university, Anton Wilhelm Brögger and Francis Bull, have already for a considerable time been deprived of their liberty. They are known to us as eminent scientists and scholars and are citizens beyond reproach. As far as we know none of them has been convicted of any crime against the laws of their country by a legal court of justice or even been accused of any criminal offence.
>
> To all of us their fate has given great pain. The fact that Professor Seip, for reasons unknown to us, has been subjected to a treatment of inhuman cruelty has further increased our anxiety on their behalf.
>
> We subscribed members of the Royal Society resident in Göteborg herewith apply to your Excellency with the request that everything in your power shall be done in order to set our fellow members at liberty and enable them to resume their studies and research.

It is greatly to be feared that any action taken by the Swedish government according to the request will be void of effect under present circumstances.

HANS PETTERSTON,
Member of the R. Society of Göteborg

MARCH 2, 1942

THE SCHOOL OF MEDICINE OF THE UNIVERSITY OF GEORGIA—A CORRECTION

A MISLEADING note as to the situation in the Medical School of the University of Georgia appeared in SCIENCE of March 20. This note implies that several of our faculty members have been dismissed for advocating coeducation of negro and white students. None of our faculty has been dismissed and the coeducation question has not been raised on our campus. The regents have given us every possible financial aid and encouragement in living up to the standards set by the American Medical Association. We have done so, and will continue to do so.

Action was taken by the council without investigating the merit of the school or of its graduates. It was apparently based upon the action of a legally constituted board of regents in dismissing administrative officers in schools in other parts of the state. Fortunately, this action does not affect the diplomas of students now in school or those entering before September first. Our dean was told by Dr. Wilbur with the full membership of the council present that no reflection was being cast upon the teaching and research of the school. Unfortunately, this was not made public.

W. F. HAMILTON

UNIVERSITY OF GEORGIA

QUOTATIONS

RUSSIAN INTERCHANGE

WE look forward when the war is over to enjoying happy relations with the Russians and to that vigorous exchange of scientific and artistic thought which is the best part of comradeship, whether between men or nations. In the meantime we are anxious to contribute in every way we can to the strength of their arms and their defences; and for the medical profession the course is plain: we would like to put at their disposal whatever information may be useful, and to find whatever equipment they need.

Something has already been done in both directions by the Anglo-Soviet Medical Committee; the appeal made by Sir Alfred Webb-Johnson, president of the committee, for surgical instruments has met with a good response which he acknowledges on another page; instruments worth about £3000 have reached him and less than 10 per cent. of these required repair. Those in perfect condition were greased and forwarded at once, while those needing overhaul or replating are being put quickly in order. A subcommittee dealing with medical supplies have been advising Mme. Maisky, wife of the Soviet Ambassador, on the purchase of surgical instruments, x-ray sets, autoclaves and other equipment, and during the past three months seventy large cases of instruments, some weighing a quarter of a ton, have been dispatched. In addition, Sir Philip Manson-Bahr and Mr. G. F. Home are compiling a book for the committee, probably to be called "Reviews of British War Medicine," consisting of articles by recognized authorities. This is being translated into Russian by doctors who have volunteered for the task and will be printed as quickly as possible and sent to Russia through the Soviet Embassy. If this volume is a success it is hoped to make it the first of a series. References and illustrations will be few, the aim being to produce a compact, informative and inexpensive book before the expected spring offensive begins. The object is not to try to teach the Russians anything (for they probably know far more about war medicine by this time than we do) but to say, in effect, "This is the way we do it. What do you think of it? And will you tell us about your own findings?" Thus the series may lead to an exchange of medical opinion which the profession in this country would greatly welcome. There are many things we should like to learn. For example, what standards do the Russians use in selection of troops? What is their age-limit for air pilots? Are they better provided than we are with rehabilitation and vocational training centres? Dr. S. Girgolov, in *Soviet War News*, the bulletin issued by the Soviet Embassy, says that for frostbite they use rapid heating of the affected part and physiotherapy, including ultrashort waves, and remove damaged tissues early, but he gives no details. He also says they are using closed plaster more and more, and are employing plasma for transfusion on a large scale. Have they had much gas gangrene? Have they used local sulphonamides widely and has their experience been the same as ours? How do they send their blood to the front line? How are they treating burns? Are they using local anesthesia for operations? Mr. Anthony Eden has already undertaken to try to arrange an exchange of information about typhus.

Many more questions spring to the mind on which shared experience would doubtless throw light; but apart from the written word what we should all like is a visit from a deputation of our Russian colleagues and the chance to exchange views and opinions and to establish a closer understanding which will help to found a lasting friendship.—*The Lancet.*

PAPER RESTRICTIONS AND THE BRITISH MEDICAL JOURNAL

THE course of the war since April, 1940, when Scandinavian sources of material for paper-making were cut off, has imposed progressive limitation upon supplies of paper, and this *Journal* in common with others has shrunk to small dimensions when judged by the standard of 1939. The shrinkage in number of pages was brought about gradually and some readers may have been scarcely aware of it until last week's very slender issue came into their hands. The reason for this attenuation is as simple as it is disagreeable. Our paper ration has suffered another and a much more drastic cut and we must eke out the supply which the Paper Control now allows us by printing fewer pages each week, and in future issues by diminishing still further the size of type used in various parts of the *Journal* and *Supplement*. Since this is a professional organ of information and opinion, owned by the members and not run for profit, the advertisement pages have to fare far worse under the axe than the editorial pages. The British Medical Association, unlike the proprietors of all newspapers and of most periodicals, can not compensate for dwindling paper supplies by materially cutting down circulation, because it is bound to send a copy of its *Journal* every week to each of the 40,000 members. Every effort will be made to economize space and to secure an adequate amount of paper, but readers and contributors must help us to make the best of a bad situation and be prepared for disappointments. The generous space given to correspondence will have to be curtailed, which means fewer and shorter letters. Every one in these days is putting up with things he never thought to endure, and we look confidently to members of the British Medical Association to exercise forbearance. As for conciseness, it has become a major virtue in all who put pen to paper.—*The British Medical Journal.*

SCIENTIFIC BOOKS

ACTIVITIES OF THE AMERICAN NATIONS

Statistical Activities of the American Nations. Edited by ELIZABETH PHELPS. Washington, D. C.: Inter American Statistical Institute. 842 + xxxi pp. 1941. $2.00.

THIS is a compendium of the statistical activities relating to the collection, processing and publication of social and economic data in the Western Hemisphere, prepared under the direction of the temporary organizing committee of the Inter American Statistical Institute. The major portion of the book consists of a series of twenty-two descriptive papers—one for each of the American republics—contributed by outstanding administrators of statistical services in the respective countries. Each of these papers gives, for the most part, a historical account of the development of statistical services in the nation concerned (in the language of that country) together with a description of the present status of statistical activities in that country. There is a considerable amount of variation in the degree of completeness of the various papers. In order to provide the reader with a ready means of making comparisons between the various countries, the editor has prepared a summary in English and also in Spanish of facts regarding the scope of the statistical work carried on in each country. A uniform set of subheadings is used for the summaries: Education Facilities; Statistical Library Facilities;

Statistical Societies or Associations; Non-Official or Semi-Official Statistical Agencies; System of Official Statistics; Principal Official Serial Statistical Publications.

An interesting and useful feature of the book is a biographical directory of the prominent statisticians (370 names) for all American nations except the United States. Appendix 1 is an excerpt from "The Economic Literature of Latin America," Harvard University Press. Appendix 2 is a report of the meeting of the statistical section of the Eighth American Scientific Congress, which was held in May, 1940.

This book is the first attempt to present a comprehensive account of what is going on statistically in North and South America. In view of the pressure of world events it is a timely document. It should at least serve to disseminate knowledge of the various statistical activities going on in the Western Hemisphere and to introduce important statisticians and statistical administrators in the hemisphere to each other.

S. S. WILKS

GLASS: THE MIRACLE MAKER

Glass: The Miracle Maker. By C. J. PHILLIPS, Corning Glass Works, Corning, N. Y. xii + 424 pp. 208 figures. 41 tables. New York: Pitman Publishing Corporation. 1941. $4.50.

"GLASS: The Miracle Maker" occupies a unique position in the relatively small library of books that are related to this subject. It can be roughly classified in a position intermediate between the type of book designed for a reader of popular science material and that intended for the glass technologist. For the former individual, the author suggests that the more technical chapters on chemistry and mechanical and physical properties be omitted if so desired. However, exclusive of these chapters, certain of the nomenclature employed in the remaining portions may cause the lay reader of science subjects some difficulty. Even with the inclusion of the aforementioned technical material the book can scarcely be considered sufficient in scope for use as a text by the student of glass technology.

The author in the foreword states: "This book is intended primarily, but not exclusively, for the architect, the civil, mechanical, electrical or chemical engineer, the industrial designer, or other industrial executive—in short, for those who may see in glass a unique and versatile material, interesting in its own right, and full of unexplored possibilities for creating products and improving production methods."

For these individuals the book has been wisely divided into two sections. Part One, devoted to History and Technology, includes the following topics: The History and Present Status of Glass; The Chemistry of Glass dealing with its constitution, composition and chemical durability; Mechanical and Other Physical Properties of Glass, including elasticity, hardness, strength, thermal endurance, density, coefficient of expansion, heat conductivity, viscosity and electrical and optical properties; Materials Handling, covering methods of unloading, storage, weighing, mixing and charging the raw materials that constitute a glass batch; Fuels, Refractories, Furnaces and the Melting Process; The Principles of Glassworking, including glass blowing, the production of mold ware, tubes and rods, casting and lamp-working; Glassworking Machinery; Finishing, Annealing, Decoration and Inspection.

In Part Two the author devotes over 160 pages to Applications and discusses the multitude of uses found for glass in architecture and building construction, in the home, in electrical transmission and communication, in illumination, in manufacture and in science and research. The last chapter considers the utilization of fiber glass. It is this latter portion of the book that is unique in its excellent portrayal of the rôle played by glass in modern civilization.

One of the outstanding features in "Glass: The Miracle Maker" is to be found in the some 150 excellent photographic illustrations. Particularly outstanding are those depicting "offhand" glass blowing and the Steuben art glass collection. Each chapter is ended with a list of references for further studying the subjects. These features go toward fulfilling the hope of the author that his book will meet the needs of engineers and industrial designers. The glass technologist himself may find in it a source of not too highly technical, yet interesting and perhaps profitable information.

The format is particularly attractive and a book mark of fiber glass is appropriately enclosed.

H. W. SAFFORD

UNIVERSITY OF PITTSBURGH

REPORTS

RESEARCHES AT MELLON INSTITUTE 1941–42

OUTSTANDING at Mellon Institute during the fiscal year ended February 28, 1942, has been the growth of the industrial research staff to 205 fellows (from 187) and 150 fellowship assistants (from 114). The services of these scientists and engineers have been required on the 95 industrial fellowships in operation.

The investigational exigencies of the emergency have in fact caused a considerable expansion in the activities of certain fellowships, particularly those concerned with coke by-products, and have resulted in many special studies for Federal Government agencies by various fellowships, such as those pertaining to heat-insulation, petroleum, plate glass, protective coatings, synthetic organic chemicals and tar synthetics. The range of the programs of most fellowships has regard for post-war economic problems. During the fiscal year from March 1, 1941, to March 1, 1942, the institute has expended $1,378,752 in carrying on its various pure and applied science projects. These particulars are brought out in the twenty-ninth annual report of the director, Dr. E. R. Weidlein, to the trustees of the institution.

In the institute's department of research in pure chemistry studies on the chemistry and chemotherapy of modified cinchona alkaloids and related synthetics have been continued. In the findings to date there has been no beneficial action of quinine which can not be accomplished equally well by hydroxyethylapocupreine, a drug which is greatly superior to quinine in pneumonia, in infections of the eye and throat and in certain asthmatic conditions. Because of the possible difficulty in obtaining adequate supplies of cinchona alkaloids, investigations are under way aimed at the production of simpler compounds which can be made from easily available materials. It is hoped that medically important chemicals can be prepared by the application of knowledge of the structural and biological relationships obtaining in the cinchona field.

In studies for the twelfth revision of the U. S. Pharmacopoeia different assay procedures for new synthetic organic chemicals have been evaluated. And much attention has been accorded to the chemical durability of glass containers for pharmaceutical solutions.

The projects subsidized by Mellon Institute at the Institute of Pathology of the Western Pennsylvania Hospital have related to chemotherapeutic and bacteriologic researches largely pertaining to the effects of the sulfonamides. A new sulfhydryl preparation has been found to possess utility in the treatment of burns. Work has proceeded on natural resistance and the common cold and on the role of certain enzymes involved in the metabolism of oxygen and carbon dioxide. The objective of the latter investigation is to acquire facts concerning the relation of these enzymes to the underlying metabolic disturbances associated with arthritis. Another program has been concerned with the bacteriology of subacute bacterial endocarditis.

Industrial Hygiene Foundation, a combined research and service association for health protection in the industries, which maintains its headquarters at Mellon Institute, is especially active these days. Battle lines in to-day's wars advance and retreat with production. The protection of industrial workers, who are forging the weapons, therefore becomes a supreme necessity, riveting attention on their health as never before in history. And rightly so, for increasing production tends to increase health hazards in industry. Unless successful remedies are swiftly applied, approximately one billion man hours will be lost through illness during 1942 when production means protection.

Investigations of Industrial Hygiene Foundation have pertained to the effects of arc-welding fumes on susceptibility to tuberculosis, to the reactions of living tissues to silica granules, to the appraisal of x-ray films for use in physical examinations in the industries and to the evaluation of present exhaust ventilation for the control of industrial health hazards. Since early in 1941 the foundation has been studying sick absenteeism in the industries. Fatigue is another topic that is getting constant consideration. The report also includes a review of the work on aluminum powder as a possible preventive in silicosis.

Nine new industrial fellowships started on their researches during the fiscal year: calcite technology, coke-plant construction materials, fur, lock-nut technology, naphthalene chemistry, packaging, pine chemicals, tape technology and tar constituents. Eight fellowships completed their investigational programs during the year. The annual publications consist of 5 bulletins, 34 research papers and 53 other articles. Fifty-three United States patents have been issued on fellowship inventions.

Of special interest is the information set forth regarding continued industrial fellowship researches. Anthrafloss is a high-grade mineral wool for insulating purposes made from anthracite by-products by the multiple fellowship of Anthracite Industries, Inc. The multiple fellowship on heat insulation and roofing has aided in the development of an efficient insulating material suitable for temperatures up to and including 1500° F. A prominent consequence of the research program of the multiple fellowship on plastic metals has been the construction of a large commercial sponge-iron plant. The activities of other fellowships have benefited gray cast-iron and steel production. Of pertinence here is the research of another fellowship on the refining of chromium. The multiple fellowship of the American Iron and Steel Institute has pursued steadily the utilization of waste pickle liquor. Research initiated by this fellowship has been conducted on five potential processes for the recovery of values from this industrial waste; the investigational work includes the recovery of free sulfuric acid and copperas, the manufacture of iron carbonate and ammonium sulfate, the production of magnesium from low-grade ores by leaching with waste pickle liquor and the preparation of sodium sulfate and ferric chloride.

In the realm of ceramics, cast-iron enameling, hollow-ware enameling materials, flat glass and waste grinding sand from plate-glass manufacture are the projects of various fellowships. The multiple fellowship on plate glass technology has brought about substantial advances in methods for evaluating flatness and texture of surfaces. Garspar, Garcolite and Gartex are being made commercially from waste grinding sand as a result of the research and development work of the mineral products fellowship. New markets have been evolved for Garspar in the fields of pottery and glass; Garcolite has been used as a pulverulent aggregate in concrete; Gartex is a processed filler for rubber, plastics and paints.

The multiple industrial fellowship on sulfur has been devoting main study to sulfur cements, to the reaction of gaseous olefins with sulfur and to the employment of sulfur as a filtering medium. The efficiency of sulfur in removing sediment from water was found to equal or surpass that of sand filters. The multiple fellowship on gas by-products has made many new inorganic and organic thiocyanates. A novel series of rubber accelerators has been discovered by this group. Other fellowships are investigating the upgrading of the components of coke-oven light oil, the physical properties of tars and pitches and their improvement, new products from tars and problems of waste disposal in the by-product coking industry. A process has been devised for the commercial recovery of cyclopentadiene, of great interest as a potential copolymer in the preparation of synthetic rubber and resins. Several types of natural gasoline and casing-head gasoline have been shown to contain amounts of isobutane and isopentane which make them desirable for sources of alkylation materials and for the production of 100-octane grade aviation fuel. The feasibility of installing a butane extraction plant has been demonstrated; normal butane is useful in the manufacture of butadiene for synthetic rubber production.

The multiple fellowship on petroleum, which has been in operation since 1911, has had another year of creative activity. The study of the chemical constitution of high melting waxes has been carried onward as has also that of the overall chemical nature of crude petroleums. Another fellowship is probing the composition of petrolatum. The twenty-eighth year of the operation of the multiple fellowship on organic synthesis has followed the usual pattern of development of new products and utilization of these chemicals to meet changing demands of the industries. Investigations on the manufacture and applications of amines, detergents, lubricants, hydraulic fluids and synthetic resins have been lengthened with success. Research in oil additives has uncovered compounds having marked detergent and anti-oxidation properties. The search for successors for chemicals unobtainable because of the war has brought forth promising products. The physiological effects of new organic compounds are being investigated by the multiple fellowship on chemical hygiene.

Mellon Institute is also quite energetic in food and nutritional research. The multiple fellowship on food varieties has perfected a new type of instant baby cereal and several novel junior foods, and a project has been begun that will survey the whole field of food flavors. A process for the rapid tenderization of meat worked out by a fellowship is now in use in 23 plants.

A fifth year of success in cotton investigation has been had by the multiple fellowship sponsored by the non-profit Cotton Research Foundation, technical agency of the National Cotton Council of America. Studies on the fiber have received most attention; investigations on the practicability and on methods of adapting virgin cotton to the manufacture of high-grade papers have been continued; fundamental research on the properties and structure of cotton cellulose and on the influence of such processes as mercerization is being conducted by novel techniques. The studies on cottonseed began to mature in encouraging fashion during the past year. The industrial fellowship on felt has devised methods which impart to paper-machine felts and other woolen industrial fabrics markedly improved physical characteristics and resistance to chemical injury. This fellowship has also worked out a process for rendering wool and wool fabrics non-shrinking and non-felting, and an improved system of wool scouring and scouring-room control that has brought an average daily increase in production of better than 75 per cent. A third textile fellowship has made important advances in the processing of hosiery yarn, particularly nylon.

The fellowship on bone products has announced methods for obtaining higher yields and grades of glue; this fellowship has lately been studying granular adsorbents for use in sugar refining. The fellowship on rubber technology is increasing its staff for fundamental studies of underlying problems of the industry. Raolin, a special chlorinated rubber, the creation of another fellowship, is being allocated according to Federal Government instructions and a substantial plant expansion program has been undertaken. Of interest in connection with needs for plastics is the program of the multiple fellowship that is engaged in research on polymerizable silicon compounds. The likely uses of these silicon derivatives are many and varied; certain applications have been proposed which have potential utility in warfare. Fellowship research is also being conducted on the employment of plastics in water and gas meters and for many other purposes.

W. A. HAMOR

SPECIAL ARTICLES

PHOSPHORYLATIVE GLYCOGENOLYSIS AND CALCIFICATION IN CARTILAGE[1]

PHOSPHORYLASE, an enzyme which catalyzes the reaction

$$\text{Glycogen} + \text{inorganic phosphate} \rightleftharpoons \text{glucose-1-phosphate}$$

(the first step in phosphorylative glycogenolysis in muscle and liver),[2] has recently been found in significant concentration in the epiphyses of growing rats and rabbits.[3] This enzyme can initiate conversion of the glycogen of hypertrophic cartilage cells into phosphoric ester substrates for cartilage (bone) phosphatase, and may thus play a significant role in the calcification of cartilage. We have investigated this by determining the effects of known inhibitors of the glycogenolytic cycle in muscle[4] upon *in vitro* calcification of cartilage (Table I).

M/100 phlorizin markedly, in some experiments almost completely, inhibited calcification of cartilage in solutions containing 8 mg per cent. Ca and 5 mg per cent. P as inorganic phosphate. M/200 phlorizin consistently caused partial but definite inhibition, M/2,000 phloretin almost completely blocked calcification. Adding glucose-1-phosphate to these solutions restored the capacity of cartilage to calcify well, even in the presence of phlorizin or phloretin. Since phlorizin and its aglycone, phloretin, principally inhibit phosphorylase activity,[4] these results imply that phosphorylase is not only present, but that its action (the formation of glucose-1-phosphate) is necessary for calcification of cartilage in a medium containing P as inorganic phosphate.

How the P of glucose-1-phosphate is then made available for the formation of bone salts apparently depends upon the activities of 3 enzymes present in calcifying cartilage: phosphorylase, phosphatase and phosphoglucomutase, all of which act upon this ester. Significant dephosphorylation of glucose-1-phosphate by phosphorylase is improbable, at least under the equilibrium conditions of *in vivo* calcification, because the glycogen stores of hypertrophic cartilage do not increase as bone salts are deposited, but disappear. Direct dephosphorylation of much glucose-1-phosphate by phosphatase is also unlikely, for reasons given elsewhere.[3] Equilibrium conditions apparently favor conversion of glucose-1-phosphate by phosphoglucomutase to glucose-6-phosphate and thereafter (by the glycolytic enzyme system known to be present in cartilage),[5] to subsequent phosphoric esters of the glycolytic series. Such, at least, is the implication of observations made by Robison and Rosenheim,[6] which we have confirmed: *in vitro* calcification of cartilage in a medium containing P only as inorganic phosphate is blocked by M/1,000 cyanide, by M/1,000

TABLE I

EFFECT OF INHIBITORS OF GLYCOGENOLYSIS ON *in vitro* CALCIFICATION OF CARTILAGE* WHEN P IS SUPPLIED AS INORGANIC PHOSPHATE, AND AS PHOSPHORIC ESTERS OF THE GLYCOGENOLYTIC SERIES (PH ADJUSTED TO 7.4; TIME 18 HOURS; TEMP. 37°C.)

Phosphoric ester added to calcifying solution†	Inhibitor	Calcification
None (inorganic P only)	none	++++
"	M/100 phlorizin	+
"	M/200 phlorizin	++
"	M/2,000 phloretin	±
Glucose-1-phosphate	M/100 phlorizin	+++
"	M/2,000 phloretin	+++
None (inorganic P only)	M/1,000 KCN	+
"	M/1,000 iodoacetate	+
"	M/10,000 NaF	±
Glucose-1-phosphate	M/1,000 KCN	+
"	M/1,000 iodoacetate	+
"	M/10,000 NaF	±
2-phosphoglycerate	M/100 phlorizin	+++
"	M/1,000 KCN	+++
"	M/1,000 iodoacetate	++++
"	M/10,000 NaF	±
a-glycerophosphate	M/100 phlorizin	+++
"	M/1,000 KCN	+++
"	M/1,000 iodoacetate	++++
"	M/10,000 NaF	++++

* We used the proximal ends of the tibiae of 20–22 day old male rats made somewhat rachitic by 8–12 days maintenance on a Steenbock-Black diet. Each tissue slice was placed in a tube containing 40 cc. control or calcifying solution, the tubes being gently rocked mechanically in a water-bath. The slices were then stained with silver nitrate.

† Solutions contained the control basal salt solution ([6]) plus 8 mg per cent. Ca as $CaCl_2$, plus 5 mg per cent. P as phosphate buffer, plus (where added) 10 mg per cent. P as phosphoric ester, plus (where added) inhibitor. All concentrations are those in the final solution. pH adjustments were made by choosing suitable phosphate buffers; where phlorizin or KCN were added, it was necessary to make further pH adjustments with $NaHCO_3$ resp. HCl.

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[1] Supported by a John A. Hartford Fund Gift. We are indebted also to Dr. D. E. Green for certain phosphoric esters and for many helpful suggestions.

[2] C. F. Cori and G. T. Cori, *Ann. Rev. Biochem.*, 10: 151, 1941.

[3] A. B. Gutman and E. B. Gutman, *Proc. Soc. Exp. Biol. and Med.*, 48: 687, 1941.

[4] J. K. Parnas, "Glykogenolyse," in Handbuch d. Enzymologie, Leipzig, 2: 902, 1940.

[5] G. M. Hills, *Biochem. Jour.*, 34: 1070, 1940.

[6] R. Robison and A. H. Rosenheim, *Biochem. Jour.*, 28: 684, 1934.

idoacetate and by M/10,000 fluoride, concentrations too low to inhibit bone phosphatase or to affect the solubility of bone salts. The inhibition by fluoride, currently believed to prevent formation of phosphopyruvate from 2-phosphoglycerate by blocking the action of enolase, indicates that dephosphorylation by phosphatase does not take place prior to that stage in the cycle. Calcification of cartilage, accordingly, involves phosphorylative glycogenolysis at least to the point of phosphopyruvate formation.

An exacting test of the role of phosphorylative glycogenolysis in this connection can be made by determining the effect of various inhibitors upon *in vitro* calcification of cartilage when P is supplied as the several phosphoric esters of the glycogenolytic series. We find that calcification with glucose-1-phosphate, in concentrations of 10 mg per cent. P, is not inhibited by phlorizin but is inhibited by cyanide, iodoacetate and fluoride; calcification with 2-phosphoglycerate is not inhibited by phlorizin, cyanide or iodoacetate but is by fluoride; calcification with α-glycerophosphate is not markedly inhibited by any of these agents. These results are consistent with what is known of phosphorylative glycogenolysis in muscle.[4] If phosphoric esters not in the series but readily dephosphorylated by bone phosphatase (β-glycerophosphate, phenylphosphate) are used, good calcification is obtained, which can not be blocked by inhibitors of glycogenolysis. If phosphoric esters not in the series and not dephosphorylated by bone phosphatase are used, calcification does not occur.

Conclusions. Calcifying cartilage contains an enzyme system for phosphorylative glycogenolysis. This system constitutes part of Robison's "second mechanism of calcification."

The processes of phosphorylative glycogenolysis are essential for *in vitro* calcification of cartilage in solutions containing P only as inorganic phosphate. They provide a mechanism whereby in such a medium lacking preformed phosphoric ester substrate for bone phosphatase, a concentration of P can be effected locally at the site of calcification in the cartilage matrix.

This mechanism probably operates in normal, *in vivo* calcification of cartilage. It could account for the selective calcification occurring in glycogen-rich primary centers of fetal ossification before erythrocytes, the only adequate source of phosphoric esters hitherto recognized, appear at the site of calcification.

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THE MILK-INFLUENCE OF BREAST TUMORS IN MICE[1]

IN this report we wish to present further data on the characteristics of the active milk-influence which plays an important role in the development of spontaneous carcinoma of the mammary glands in mice.[2,3]

Details of the experiments were as follows. Lactating females of the cancerous A strain were killed on 2/6/41 and their mammary glands removed. The tissue was macerated in a tissue-press and forced through a disc having openings 0.045 of an inch. The macerated material was filtered, using a fine wire cloth and 38 cc of milk, etc., was obtained to which was added an equal amount of sterile physiological salt solution. The extract was filtered through a Seitz filter and the filtrate (called filtrate A) was injected subcutaneously or intraperitoneally into 15 mice of the fostered C3H strain. The incidence of breast tumors in breeding females of the fostered C3H strain is about 2 per cent. The injected animals, as were all the mice used in these studies, were four weeks of age at the time of treatment and each received 2 cc of the filtrate. Nine of the injected mice have developed breast tumors, one has died non-cancerous and the others are living. All the females in this and the following experiments were used as breeders.

To the macerated tissue and the unfiltered residue of filtrate A was added 40 cc of distilled water. The extract secured following filtering with a wire cloth was filtered through the Seitz filter. This filtrate (called filtrate B) was injected, as above, into 12 females of the fostered C3H stock. Ten mice have developed breast tumors.

To determine if the unfiltered material contained the active milk-influence, 17 fostered C3H mice were given, in small dishes, the unfiltered residue and the macerated tissue diluted 1:3 with water. The average amount given per mouse was 7 cc, and most of the material was consumed. Fourteen of these females have developed breast tumors, 2 are living and 1 died non-cancerous.

Mice receiving the filtrates developed tumors at an average age of 287 days and the females receiving the unfiltered extract at 244 days.

On 4/17/41, 75 cc of distilled water was added to 15 cc of macerated breast tumors (tissue-press). The extract was given by mouth to 13 mice of the fostered C3H stock and 6 females of the BAF_1 generation (C57 black ♀ × A ♂, normal incidence of breast tumors, 1 per cent.).[3] The average amount given per female was 3.8 cc. Nine fostered C3H and 1 BAF_1

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[1] Assisted by grants from the National Cancer Institute and The Jane Coffin Childs Memorial Fund for Medical Research.

[2] J. J. Bittner, SCIENCE, 84: 162, 1936.

[3] *Idem,* Trans. and Studies of the College of Physicians of Philadelphia, 9: 129, 1941.

females have had breast tumors, 1 C3H mouse died at an early age and the others are living.

To the residue of the tumor-tissue was added an equal amount of 50 per cent. glycerin. This was placed in the refrigerator on 4/17/41, shaken daily and filtered through a wire cloth on 4/24/41. Twenty-five cc of filtered substance was obtained to which was added 40 cc of Locke's solution. The extract was injected intraperitoneally into 16 fostered C3H females (2 cc, each mouse) and 8 BAF$_1$ females (1 cc, each mouse). Five of the C3H females have developed spontaneous breast tumors; the others are living.

On 5/6/41 an extract of 30 cc of macerated tissue of spontaneous breast tumors and 90 cc of 50 per cent. glycerin was placed in the refrigerator, shaken daily until 5/15/41, when it was removed and filtered (wire cloth). Seventy-five cc of filtrate was obtained to which was added 140 cc of Locke's solution. Fifty-five mice were injected intraperitoneally, each receiving 1 cc. As 43 of the injected mice were dead by the following morning, the others were given the extract in small dishes. The average amount given was 4 cc per animal but little of the material was consumed in two days. Five BAF$_1$ and 7 fostered C3H females survived the treatment and tumors have been observed to develop in two of the hybrid animals.

SUMMARY

Females of the fostered C3H strain and the BAF$_1$ hybrid generation, having a normal incidence of breast tumors of 1–2 per cent., were given, by mouth or injection, filtrates (Seitz filter) or extracts of glycerinated-treated tissue containing the active milk-influence for the development of spontaneous breast cancer. Sixty-three experimental mice were observed to have an incidence of 41 per cent. Thirty-six mice received unfiltered or untreated material and have had an incidence of 67 per cent. Many of the mice of each group are still living.

Previous studies indicated that the active milk-influence would not become inactive following desiccation.[4] Following ultracentrifugation the active influence appeared in traces, if at all, in the fat fraction and in the final supernatant fluid, and it is possible that the active agent is a colloid of high molecular weight.[5]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MEANS OF INCREASING THE ILLUSION OF DEPTH IN PHOTOGRAPHS

PHOTOGRAPHS used in scientific illustration generally lack the illusion of depth or three dimensions. The recent introduction and use of film transparencies (translites) has made available a means of obtaining the third-dimensional effect in photographs. "Translites" when held up to the light and viewed from a distance of two or three feet give the optimum of third-dimensional illusion or effect.

An easy, inexpensive means of mounting and viewing the transparencies in front of the laboratory windows is herein described. The films are mounted in metal frames between two sheets of glass. The dimensions of the frames used by us are twenty-two by twenty-nine inches and they hold nine translite films (seven by nine inches) arranged in three rows of three each. The metal frames were obtained from the Multiplex Corporation of St. Louis, Mo.

The frames are held in front of the windows by the following means. Two deeply grooved wooden tracks or window bars are used to keep the frames upright in the lower part of the window. The lower grooved track is permanently fastened to the framework of the window. The upper detachable grooved track is fastened to the framework of the window by means of two bolts passing through holes at each end of the bar and fastened by wing nuts. The upper bar can easily be unfastened to insert the frame containing the translite films. Several frames may be placed in a window and the ventilation or illumination of the room is not appreciably decreased (see Fig. 1 A and B).

Since the films are placed between two sheets of glass, they are not liable to injury by frequent handling and therefore retain their usefulness indefinitely. This method of illustration had been found to be much superior to ordinary photographs and greatly enhances the illusion of the third dimension or depth in photographs.

"Translites" may be made on either translite film or paper (Eastman Kodak). The paper is less expensive than the film, but it does not have the same degree of brilliance or transparency. Each side of the translite film or paper is coated with a photographic emulsion. These emulsions are of different speeds so that when developed the two images are of different densities and are separated from each other by the thickness of the paper or film. The illusion of depth is thus readily obtained when these double-coated, two image films or papers are viewed from a distance of several feet.

Photographic negatives of medium contrast taken in the usual manner are used in making the translites.

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[4] *Idem*, SCIENCE, 93: 527, 1941.

[5] M. B. Visscher, R. G. Green and J. J. Bittner, *Proc. Soc. Exp. Biol. and Med.*, 49: 94, 1942.

The same procedure is followed as in making ordinary enlargements on bromide or chloro-bromide papers except that translite film or paper is used instead.

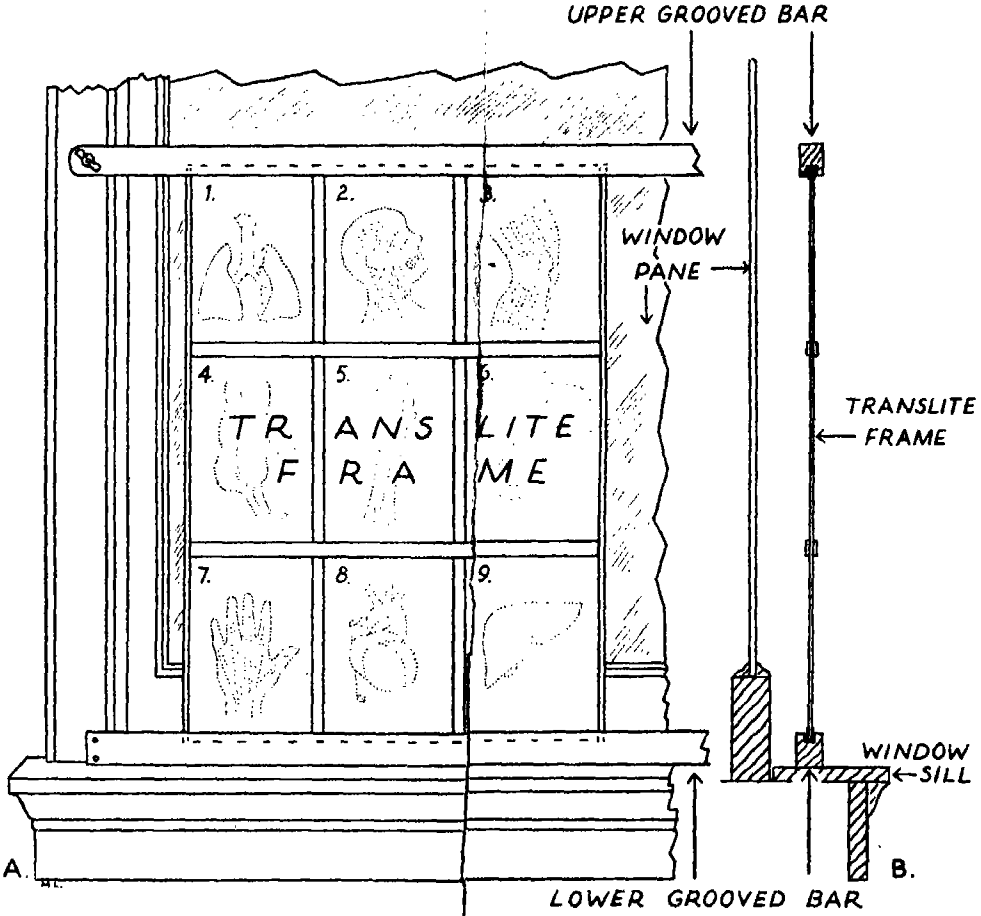

FIG. 1. Front (A) and cross-sectional (B) view of window frame with translites in place for viewing. The translite frame may be removed from the window by unscrewing the wing nut fastening one end of the upper grooved bar.

The translite film or paper requires no special technique in handling and developing. The development, the fixing and the washing of the translite film or paper is similar to that employed in preparing ordinary photographs. Wide variations in exposure of the translite film are possible since the translite film has a rather wide latitude.

Translites may easily be made to resemble the specimen more closely by the application of coloring pigments directly to either side of the film or paper. Eastman Transparent Oil Colors are best suited and should be used undiluted and applied directly with cotton applicators and then blended. Excess color may be removed easily by means of "thinner" applied in a similar manner.

Photography has been used as an inexpensive means of recording detail of preparations, etc., for further study. Ordinary photographs usually fail to create the illusion of depth so that it becomes difficult to determine the relationship of successively deeper planes to one another. The use of translites enhances the illusion of depth, and this means of mounting and illuminating translites is efficient and inexpensive.

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BOOKS RECEIVED

BOAL, SAM J. *Gardening—Without Bunk.* Pp. 145. Putnam. $1.75.

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HUME, EDGAR ERSKINE. *Ornithologists of the United States Army Medical Corps.* Illustrated. Pp. xxv + 583. Johns Hopkins Press. $5.00.

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Sun Chief: The Autobiography of a Hopi Indian. Edited by LEO W. SIMMONS. Illustrated. Pp. xi + 460. Yale University Press. $4.25.

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CONSERVING OUR HARVESTS[1]

By F. C. BRADFORD

U. S. DEPARTMENT OF AGRICULTURE, GLENN DALE, MD.

Three and a half centuries ago Francis Bacon said "I take all knowledge to be my sphere." Though competent scholars state that Bacon was far from having full knowledge of the science of his day, his aspiration was not ridiculous or even particularly remarkable in his time, and had he given to science half the time he devoted to statecraft he might well have mastered all the science that was then known. An Italian contemporary of Bacon, Giambattista della Porta, made studies which are still mentioned in histories of optics, included in his extensive "Magia Naturalis," a chapter on producing new plants—probably the first organized article on plant breeding—wrote a work on plant signatures and in modern literary histories he is discussed as the leader of the notable group of writers of Italian comedies in a period when Italian comedy was the most notable literary movement in the world. A century later the best-known English writer on gardening, John Evelyn, by whom greenhouse heating was considerably advanced and gardening made respectable, was only a part-time horticulturist; he was also an authority on some of the fine arts and rather constantly engaged with public affairs. Most of the German pomologists of the early nineteenth century made their extensive varietal studies and wrote their monumental works in time spared from their labors as pastors or teachers. When our own agricultural colleges and experiment stations were organized, nearly two centuries after Evelyn, full-time horticulturists were rare in their staffs; most of the pioneer teachers and investigators not only worked on the various phases of horticulture, but also served either as botanists, entomologists or pathologists and sometimes as foresters and superintendents of grounds. Many horticulturists now in active service have taught or investigated pomology, olericulture, greenhouse construction, floriculture, plant breeding and landscape gardening. They have in numerous cases seen one-man departments grow into sectionalized departments, with staffs of 20 to 30 men.

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[1] Address of the president of the American Society for Horticultural Science, Dallas, Texas, December 30, 1941.

The two needs most conspicuous when this expansion began, research and extension, have received most attention, with results that are most gratifying. The successive volumes of *Proceedings* of this society provide a graphic presentation of cumulative increase in horticultural research. If all vehicles of publication of horticultural investigation were considered, the equation representing the increase might approach that of accelerated motion. Increase in horticultural research is not confined to the United States. Many other nations have research stations doing work of a high order, most of them comparatively new. As an example, it may be noted that pollination studies on the Bartlett pear have been reported in Australia, Canada, South Africa, Switzerland, Germany, England, the Scandinavian countries, the United States and possibly other countries. There need be no concern about quantity.

The *Proceedings* of this society also illustrate very well a great improvement in the quality of the work done; the increasingly frequent appearance of articles by horticulturists in the journals of the pure sciences furnishes additional evidence of the quality of the research done in horticultural departments and, conversely, physiologists and anatomists are increasingly utilizing horticultural material in their own research. It is true that improvement in quality is still needed, here and there, but the best promise of that improvement is the self-examining attitude of research workers, and their concern for the quality of their work. Some improvement in choice of problems, more concerted attack from various angles, are needed, but these concern direction of research primarily, rather than its excellence.

On the whole, then, our research work is sound and with proper support can be relied on to continue in that condition, so far as present signs are indicative.

The very productiveness of research and its advanced nature have, however, created a new problem, rapidly becoming acute, through the inadequacy of the existing mechanism to the task of digesting and assimilating research results, incorporating them into the existing body of information, with such modifications of this body as they may necessitate, to the end that the whole body of information is always complete and always ready for use. Thirty years or so ago, this problem was much less pressing. There is abundant evidence that the horticultural teaching of that period was far from utilizing all the information then in existence, largely because it was not in readily available form, and the horticultural teacher of those days had too many subjects to cover to permit him to develop any subject thoroughly by library research. In spite of this failure to utilize existing information already stored on library shelves, the horticultural investigator and teacher had no great difficulty in keeping abreast of current investigations on horticultural crops. The first comprehensive American experiments on orchard fertilization and orchard management were just approaching publication; spraying employed only three or four standard materials; the first serious studies on storage were still new. Most of the experiment station work was published in bulletins and these were so few that each one was studied and discussed by all horticultural investigators and teachers. The average investigator of that period worked on projects covering nearly the whole range of horticulture and could keep abreast of current literature on all of them without losing much sleep. A volume of the size of any of our *Proceedings* would contain all the horticultural research published in several years in the earlier period.

Thus little more than thirty years of horticultural research and teaching have developed a stage of specialization so advanced that in the institutions with the larger staffs each member, it has been said, continually knows more and more about less and less. Sheer abundance of information is increasingly circumscribing the field in which each man can keep thoroughly or even well informed. In many fields the investigator could spend so much of his time reading pertinent literature that he would have scant time for research of his own. It is doubtful whether any student of hormones could read all the papers on hormones that have been printed in the last ten—or even five—years and still do research. The student who would read all current literature on citrus fruits in the original papers would need command of at least English, French, German, Spanish, Portuguese, Italian, Russian, Dutch and Japanese. If the literature on limited fields taxes or exceeds the time and energy of the specialist in those particular fields, it is manifest that he must fail to keep well acquainted with related fields and his reference to them throughout his working life is in many cases based on what he learned in college.

Changes in the techniques of investigation have been even greater than those in quantity. Chemical methods, plant physiological techniques, virtually unknown in horticultural investigation 35 years ago, have become common. Statistical analysis was then new in the biological sciences, and no horticultural research had been placed under its scrutiny. Genetics was a new term. Little was known about plant viruses. Each of these techniques is ever progressing, each has its own growing literature. Thus modernization of implementation requires that the investigator be constantly alert; this in itself is a considerable task. The increasing requirements of attention to methodology inevitably limit the time available for thoughtful study of literature of those phases of horticulture that do not occupy the investigator at the moment. Little by little each of us has been forced to neglect readings we should accomplish. No other course is open. That we may retain even approximately complete command of some subjects, we must leave others rather largely in status quo, and before long our occasional dealings with them are made with incomplete knowledge.

Wisdom is not a new invention. If research is sound its value is not ephemeral. None the less the very machine that was created to produce facts is by its own exacting requirements and its productivity burying facts under other facts unless they have an immediate cash value. It would be very comforting could we believe that some vaguely defined buoyancy kept everything valuable afloat on the surface while the trivia were engulfed; unfortunately this is not the case. Discoveries of great value have been ignored because their importance seemed small at the moment of their enunciation. When Nicholas Longworth induced the son of a Cincinnati market gardener to reveal the secret of securing crops from pistillate strawberries, the use of pollenizers quickly became general and was not forgotten, because pistillate varieties were being grown commercially. This "secret" had, however, been published in England in 1815 and in France nearly 50 years earlier than that and had been forgotten because it had no important immediate application. These reports were not in obscure journals; one had been published in the Transactions of the Royal Society; the other in a standard book. Mere publication evidently is not enough to insure continued recognition.

We who are here present will collectively hear literally hundreds of papers at this session; these will be neatly printed and the collection will take its place on library shelves, alongside thirty-odd similar volumes. But this is not the end. Research will not die with the closing of this session. Another volume will be added next year and the next and so on. The students who come into the field in 1951 will be so busy reading the new volumes that few of them will ever get back along the shelf to the 1941 volume unless specific reference sends them to it. Thus the study that can not at once be tied to something useful can become buried in 1941 as in 1760. If this material is worth the time, effort and resources that have gone into its preparation and publication, it is worth the additional effort that will be necessary to keep it accessible.

This confusion—if not chaos—into which we are proceeding at a rapid rate is due to our failure to recognize our increase in wealth. We are still using the machinery and methods that were reasonably adequate 40 to 50 years ago, unconscious that we have outgrown them.

Specialization has beyond question been productive of good results, but doubt may well be raised as to whether, in its present form, it can continue to function smoothly when the influence now exerted by the older men with broad experience is no longer felt. Already there are disturbing signs. Sometimes recommendations are made to alleviate one difficulty, without due consideration of all the effects of these recommendations, simply because the other effects lie beyond the specialist's purview. When staffs are composed entirely of specialists the lack of integration is likely to become acute. On the other hand, wide areas, thousands of farmers, still take their immediate guidance from horticultural staffs so small that one man may be their reliance in a wide diversity of subjects as, conceivably, rootstocks, winter injury, boron deficiency and fruit storage. A position with this responsibility needs a more capable man than is required for any single position in a large staff. Usually a man in this situation has the most meager library facilities and the greatest imperative demand on his time. It is not surprising, therefore, that in occasional cases a practical grower has quoted published research of which the investigator had not heard.

This condition has developed, obviously, through nobody's intent and many are still unaware of its existence. The investigator naturally does not advertise his failures to keep fully abreast of the times. The administrative official can not know many fields as well as the specialists in those fields know them, and as long as their work is good he must assume that it could not be better. If he has suspicion that some phases are being neglected his usual remedy is to hire another investigator.

Responsibility for this situation rests basically even more on the colleges of agriculture than it does on the experiment stations. They have followed the pure sciences in exalting the investigator and ignoring the scholar. The whole structure of the requirement for the advanced degrees—particularly the doctorate—in agricultural subjects as in pure sciences reflects this with the greatest clarity. In the days when advanced degrees were first awarded, the literature of science was so comparatively limited that mastery of it was easily attained by the candidate and his thesis was required to demonstrate his ability to conduct independent research. Thus, the early doctors of philosophy could legitimately claim to be scholars and investigators. For some time it has been apparent that doctorates are being awarded to men who do not know thoroughly the literature of even their own science beyond the field of their theses, but no official recognition has been made of the polite anachronism involved in welcoming doctors of philosophy into fellowship of scholars. Despite the great change in lines of work followed by graduates of agricultural colleges, despite their influx into industries connected with agriculture, the graduate student who wishes a degree, whatever his purpose, must still demonstrate his ability to conduct independent research. A teacher in a Smith-Hughes agricultural high school who wishes to supplement the studies covered in his undergraduate curriculum may need advanced courses in many branches of agriculture, but if he wishes the master's degree as a token of extra study beyond the baccalaureate degree he must abandon thought of advanced courses in various agricultural subjects, concentrate on one and demonstrate through a thesis that he can conduct investigation. When he has done this, he may secure an increase in the stipend he is paid for teaching. A youth contemplating a career in industries related to agriculture is likely to secure better preparation for this career by taking the bachelor's degree in two institutions than he will by taking graduate work. Many respectable institutions are now conferring the master's degree for advanced course work, but agricultural colleges rather uniformly seem to be content to pour all their material into the old moulds. Agricultural study was once hailed as an escape from the rigid requirements of the old classical curriculum; with age it seems to become rigid in its own way.

Every institution which awards the doctorate in literature and in history grants it for work which in the scientific field would be called discussion of the literature. There is no question of the value of this kind of work or of its repetition; the factual records of history may not change, but their interpretation changes with every generation. Only in pure science and in agriculture is this type of study without formal recognition. Official agriculture, whose every effort is sincerely in the direction of making the world's knowledge available to the humblest farmer, expends great effort on research and in extension but assumes that systematization of information is an autocatalytic reaction.

Were the effects of this present traditional grooving confined to the misfortunes of the individual students who do not fit into it, they would be deplorable enough. Actually they reach much farther and affect us all. The standard requirement for the advanced degree exalts research work and inevitably establishes some unfortunate implications of relative values of different legs of the table. This notion is all too common. Naturally it leads to differences in preferment. Extension men have their methods of securing reward, often through "pressure groups," and administrative officials appear to secure a glow of mellow feeling from rewarding the work of the successful research man, who, presumably, exerts no pressure. When these groups are cared for, if there is any balance, part of it is given to the teachers—unless the campus needs new sidewalks. Scholarship fares better in the humanities than it does in the sciences—or in agriculture.

Thus the cycle is maintained. The horticulturist soon becomes aware of the directions in which lies preferment and he "builds his fences out in the state" or he pushes his research—in any case he neglects his teaching in greater or lesser degree. The bright ambitious young man seeks ardently for full-time research or goes into extension, and the passing of time finds considerable numbers of men doing teaching because they were complacent and lacked aggressiveness, rather than through any special aptitude. Teaching done by the research man is all too frequently very minute, detailed and exact in the portion of the course that pertains to his particular field of research and very shabby in the other portions. Sometimes two thirds of the student's time in the course is given to the teacher's research field and the remaining third to the rest of the subject. This is an easy way of discharging an unwelcome task.

Unfortunately a teacher's success can not be measured accurately until the students he had in his middle age have themselves become middle-aged. Administrative officials have some real difficulty in this appraisal, for they can not widely rely very much on student opinion. They could, however, assure themselves that the candidate teacher is a scholar through the guarantee of his mastery of the literature of his subject that is implied in a degree awarded for scholarship, far better than by his standing as an investigator of a limited portion of the subject he teaches. Attainment of a degree awarded for scholarly mastery of a subject, without reference to research proficiency, should be the preferred standard for selection of teaching personnel. Were all agricultural students prospective investigators, the present arrangement would be satisfactory; they are not, and it is not.

Scholarly systematization of knowledge and its publication could well form a part of the program of every institution. Publication of such works should not drain seriously the publication funds, for if proper standards are maintained, contributions of this sort will be far less numerous than the research papers. Publication of critical literature reviews would have several beneficial effects; it would make readily accessible in a few minutes information whose gathering and collation required months and years; it would grant recognition to those who perform these labors and it would invite appraisal of the quality of their work, as do the papers written by investigators. Unwisely executed, this effort would be perilous for it could become misleading. High standards should be exacted and consultation with many specialists would be necessary; the work should be critical review and not unquestioning compilation.

The influence exerted by men whose chief responsibility and greatest distinction lay in providing complete, digested and evaluated information would be felt in many directions. It would constitute a strong force in a direction needed now more than ever, namely, coordination of research. It would relieve investigators of much of the labor of searching through great masses of reading to glean a small grist of pertinent matter, though it should not relieve them of responsibility for study of this modicum. More than one productive new line of investigation has been suggested only after assembly and review of all the available pertinent facts. With specialization becoming more advanced, men of this somewhat more general training could be of great value to administration of horticultural organizations.

Investigators are relying increasingly on abstract journals to bring their general information down to date. Therefore it is most humiliating to be forced to acknowledge that lack of support is making abstract journals increasingly inadequate. To secure reasonably complete coverage of horticultural literature, its student must resort to foreign abstract journals, admirably conducted, but still abstracted abroad and principally for use abroad. As a rule, abstracting done abroad is a paid service; in the United States it is almost entirely voluntary. This may have some influence on the results, but much more inhibitory on the usefulness of our abstract journals is the limit placed by lack of funds on the space that can be allotted to any subject. This situation could doubtless be remedied by proper presentation of the value of the service and of its present inadequate coverage. It is possible, too, that abstract journals could increase their usefulness and their revenues by adopting a format lending itself to printing and sale of reprint separates that could be distributed readily into various files.

Though improvement of our abstract journals is very important and should be pushed energetically, principally by better support, these journals can not, however well conducted and however voluminous, be more than an adjunct in keeping our information continuously organized. Let any one who doubts this statement drop all pertinent notes on any one subject into a file for ten or even five years, and then try to comprehend the mass in time to answer a telephone call. Librarians' lists of titles give only a start in this direction, for titles are often misleading as to content. Sporadic literature reviews introducing reports of investigation are increasingly inadequate, for they properly ignore material not relevant to the investigation and they do not constitute a uniform progression covering a whole field. Whatever devices may be tried, there is no escaping the need of men trained in horticultural scholarship. These men should know the art of horticulture and know the supporting sciences; their linguistic attainments should be extensive; their geographic and historical knowledge should be adequate to permit evaluation of any piece of research in relation to its background; they should be proficient in finding, collating, organizing and presenting information. They should find their chief delight in doing work of this nature. They must be able to consult freely with appropriate specialists for critical evaluation of research reports. This is, to be sure, almost the identical set of specifications that should be used in developing a good teacher. It involves far more, however, than it did a few years ago in preparation, attainments and experience and it deviates rather considerably from the work reasonably expected of an investigator. That it is not often realized at present is due to our persistent effort to make teachers out of men trained to be investigators. Work of this sort needs, therefore, official recognition as a definite career, honored equally with cognate lines of effort, with a definite line of approach, a definite outlet for its products, definite allowance of time and resources for its pursuit and definite reward for excellence in attainment. The man thus trained and thus employed could well become more than a specialist engaged to cure the effects of specialization; he is the most likely of all to develop into the architect who builds structures from materials made by many men. Let us remember that Darwin accomplished as much or more by putting together scattered bits of information brought forth by others than he did by his own personal investigations.

UNVEILING OF THE BUST OF HENRY FAIRFIELD OSBORN AT THE AMERICAN MUSEUM OF NATURAL HISTORY[1]

THE unveiling of the bust of Henry Fairfield Osborn and the opening of the new Hall of North American Mammals are appropriately brought together in one meeting. To Osborn's enthusiasm and unconquerable energy we owe this entire memorial building, dedicated to his friend and fellow-naturalist, Theodore Roosevelt. This building in turn forms a perfect setting for the new hall, which is filled with superb mounts of the larger North American mammals in their native haunts—beloved alike by Roosevelt and Osborn. Finally it was Osborn's life-long admiration of the larger mammals, living and extinct, which attracted to him such men as Madison Grant, Harold E. Anthony and James L. Clark, who have made Osborn's dream a glorious reality.

Osborn's scientific studies on fossil mammals began in 1877, when he and several of his classmates at Princeton, including his close friend and colleague, William Berryman Scott, made their famous first expedition to the Bridger Eocene basin of Wyoming. Here they discovered enough strange extinct forms of mammalian life to give them an uncontrollable urge to discover more. From this expedition sprang a long and ever-branching system of explorations, at Princeton under Scott and at the American Museum under Osborn. From the Flaming Cliffs of the Gobi Desert and the withering slopes of the Siwaliks in India to the frozen soil of Alaska, many a "valley of dry bones" has heard the clang of the explorer's pick and yielded up its dead. Under the spell of the prophet the dry bones came together and thus it happened that in our temple of science many an ancient leviathan rears his mighty frame before us.

All this and much more was set in motion by Osborn, who often went into the field himself; but he always gave full credit to his captains and other men whom he had inspired and trained in the science of paleontology. In such a roll of honor he would undoubtedly himself inscribe the names of Matthew, Granger, Brown, Lull, Forster-Cooper, Andrews, Frick. And among the younger men of to-day are several to whom he was happy to entrust the future of paleontology.

As a student of Huxley and a disciple of Darwin, Osborn developed a broad interest in many branches of the biological sciences, as shown in his general work "The Origin and Evolution of Life"; but his most intensive work was in the field of mammalian paleontology. His first important memoir was a systematic revision and study of the fossil teeth and jaws of the tiny mammals which were the contemporaries of the dinosaurs. Quite early (1888) began his interest in the evolution of mammalian molar teeth. Cope had already supplied the first key to the interpretation of the origin of the complex folds on the surface of the crowns of the molar teeth of herbivorous mammals. Osborn very successfully used this "tritubercular key," as he called it, to decipher the historical stages in the evolution of the molar teeth in the families of the horses, rhinoceroses, titanotheres, tapirs and many others. Even at the present time, making all due allowances for later discoveries and corrections, this Cope-Osborn theory is widely and usefully applied by many paleontologists.

In his later years Osborn undertook to prepare a series of great monographs on the histories of the families of horses, titanotheres and proboscideans or mastodonts and elephants. In view of the heavy demands on his time from many other directions, his achievements in this field were truly enormous. The monograph on the titanotheres, numbering 953 large quarto pages, 797 text figures and 236 plates, was published in 1929. The great two-volume monograph on the Proboscidea was not completed until long after his death, the second volume having been published last month. But apart from one signed chapter on the geology of the Proboscidea, which is contributed by Dr. Colbert, one of Professor Osborn's former assistants, all the essential parts of this monograph are exclusively his own and they have been assembled and edited according to his own plan by his former secretary, Miss Mabel R. Percy.

These two great works stand out among the 940-odd entries in his bibliography and will be consulted as long as paleontology remains a living science. In spite of the vast complexity of the family tree of the proboscidea and of the many gaps that still remain in the record, this monograph presents cumulative evidence that the molar teeth, tusks and other parts of the ancestral elephants have become modified in the various ways described by Osborn. But those who prefer to ignore or to ridicule such evidence for the reality of evolution as an historical process will doubtless continue to rely upon their dialectic skill and strive to prove that evolution is not a fact because it is impossible.

Osborn's greatness as a scientist depended upon his greatness as a man. His vision, enthusiasm, conviction, persistence, persuasiveness, tolerance and restraint made him successful both as leader and investigator. Indeed those of us who were close to him as a scientist immediately felt and responded to his benign influence as a man.

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[1] Addresses at the unveiling of the bust of Professor Osborn, April 8, 1942.

The portrait in bronze by Joy Flinsch Buba, which will presently be unveiled, while almost Olympian in its impression, will bring us face to face with Osborn the scientist, philosopher and friend, as we knew him in his later years. But this vital record in bronze may also suggest to us the young Osborn, fresh from his contact with Darwin and Huxley, and already inspired with the first vision of evolution, which culminated in his monograph on the Proboscidea.

WILLIAM K. GREGORY
AMERICAN MUSEUM OF NATURAL HISTORY

THE contribution which men make to the advancement of a civilization can never be accurately assessed and least of all by contemporaries who inevitably tend to exaggerate the importance of existing conditions which often prove ephemeral. Moreover, the seed which men sow frequently flowers long afterward and is consequently overlooked during their lifetime and immediately thereafter. Furthermore, acts, ideas, convictions which may elicit current criticism and disparagement not infrequently prove later to have been abundantly justified. Both for what they do and for what they fail to do, men are often misjudged and the near view of them is by no means to be regarded as entirely reliable.

The man whose memory we are gathered to honor to-day is, fortunately, immune to any serious peril of lack of appreciation, although only time will approximate a just evaluation of his accomplishments. His greatest contributions live on in this great institution which he served so long and so brilliantly. As himself an eminent scientist, constantly contributing to push forward the boundaries of knowledge, by his example inspiring the members of his staff and scientists everywhere to similar achievements, not less than by his administrative ability and his talent for interesting generous benefactors in the support of this enterprise, he left an indelible imprint upon his time. He put this museum into the very forefront of the great scientific agencies of the period, stimulating throughout the nation a new understanding of the educational power of such institutions, while serving this great metropolitan community by opening ever wider to its citizens the unrivaled wealth of its superb collections. In all this undertaking he worked side by side with his loyal colleagues in the organization—*primus inter pares.*

He was deeply enamored of the term "creative" and of the idea behind it. In a sense every voluntary act that anyone performs is creative. It initiates changes in previously existing conditions, even as it was itself brought into being by preceding acts and events. Such a conception of creation is true, but it is sterile so far as concerns the situations in which Osborn was primarily interested. It is the notion of the creative which is discovered in the work of the artist, or the explorer and the research worker which embodies the ideals that Osborn had in mind and whose worth seemed to him supreme in the world of mind. The clearly formed purpose, the definitely articulated objective, the carefully planned method of attack, the tireless and ingenious pursuit of the end sought, the untiring and courageous tenacity which can not be discouraged or disheartened—these are among the important qualities which enter into the creative thinking and conduct that kindled Osborn's enthusiasm and enlisted his support.

In the work of the artist there may appear to be more of the purely spontaneous than in that of the scientific research worker, yet the greatest works of art all reveal deep underlying purposes, involving the most careful planning, and an enormous investment of tedious labor in their realization. The Parthenon, the Dome of St. Peters, Giotti's Tower, Raphael's Transfiguration, Milton's "Paradise Lost," Dante's "Divine Comedy"—one can extend the list indefinitely—are all adventures of the human spirit in the creation of enduring values into whose production have entered many of the most precious gifts of sheer intelligence.

But Osborn's interest in creative thinking was naturally not confined to the initial process of planning, nor to the merely conscientious and laborious search for new facts. It inevitably included the effort to enlarge the horizons of recognized truth, to set new discoveries in effective relation to established knowledge, to formulate fresh and broader principles, more revealing correlations than those which had previously been understood or accepted.

In this process his own work came at times under severe attack, for while the well-authenticated fact is reasonably immune to assault, the inferences based upon it, the generalizations arising out of the effort to orient it amid other data and principles, unavoidably lead to corrective interpretation at other hands. The man of sincere scientific spirit is never seriously irked by this experience, provided he be not essentially misrepresented, for much of this kind of rough and tumble is inevitable in all progress. Osborn certainly had his full share of this type of conflict and would unquestionably accept with good grace such corrections and modifications of his own views as with the passing of the years the development of scientific knowledge may involve. Nor does it follow that because his own particular views may in certain cases fail to prevail, his contribution is in any way to be held lightly. Quite the contrary is the fact. Such approximation to truth as the human mind can ever attain is always the result of the clarifying increments made by successive generations of thoughtful men.

Men possessing such a combination of qualities as those of Henry Fairfield Osborn are all too rare. The good administrator is a familiar figure, the eminent scientist has many exemplars, even the scientist of deeply religious convictions, such as Osborn held, is by no means unknown; but it is *extremely rare* to find these gifts combined in one man, and when they are conjoined with a remarkable charm of personality and sterling integrity of character, we are confronted with one of the most unusual of the benefactions of a generous Providence.

Such a man was he in whose honor we have assembled in this place he loved. A distinguished scientist, a faithful friend, a great citizen—his memory will be kept ever green as long as this institution endures.

JAMES R. ANGELL

THE NATIONAL BROADCASTING COMPANY

OBITUARY

RAYMOND DODGE

RAYMOND DODGE, A.B., Williams, 1893; Ph.D., Halle, 1896; honorary Sc.D., Williams, 1918; emeritus professor in Yale University, died on April 8 at the age of 71 years. He was born in Woburn, Massachusetts, in 1871.

In the death of Professor Dodge, American psychology has lost one of its most stalwart pioneers. Few of his contemporaries have made so fundamental contributions and had so little occasion to recant. Endowed with a fertile imagination, practical ingenuity, far-sighted perseverance and a critical and philosophical bent of mind, he became a bold and rigorous experimenter in the development of psychological techniques and in the implementation of his findings both in theory and widely varied applications. He was a level-headed and inspiring person. Young psychologists might well find in him a model of an upright scientist.

We note six distinct epochs in his career: his formative period in philosophy at Williams; his association with Benno Erdmann in Halle; the 26 years of teaching and research at Wesleyan University, Connecticut; the association with Benedict in research on nutrition in the Carnegie Institution of Nutrition; the war episode; and the professorship at Yale.

After a year of graduate work at Williams he went to Germany to continue his studies in philosophy. He there set up a life-long and intimate association with Professor Erdmann, took his doctorate under him and became his assistant and collaborator in extensive researches and publications in the field of experimental psychology of reading which he long regarded as his specific field of investigation, particularly the field of eye movements. For this he built the Erdmann-Dodge tachistoscope, the Dodge mirror tachistoscope and an apparatus for the photographing of eye movements. With each of these instruments he found scores of applications. He was the first to measure and classify eye movements and to utilize that technique in pure psychology, education, physiology, pharmacology, psychiatry and war.

In 1909–1910 he had sabbatical leave and spent one semester in the Marey Institute in Paris and another in Göttingen with the physiologist, Max Verworn. Here he also became closely associated with G. E. Müller in psycho-physics. In 1916–1918 he took leave of absence from Wesleyan and spent two years in research in Columbia University having to do mainly with neurophysiological characteristics of human variability. Later he spent one year in the nutrition laboratory of the Carnegie Institution studying the psychomotor effects of light doses of alcohol.

With the coming of the war he entered war services with extraordinary vigor. In the Navy service he invented an instrumental device for the selection and training of gunners which has had wide and effective use. Of his activities in World War I he writes in his autobiography:

> My second excursion into the applied field was during the Great War. It really amounted to a concentration of my entire scientific experience into a few months of agonizing exploitation. Probably no one else on the Psychological Committee except the chairman had the privilege of participating in so many phases of war service. I was a member of the original planning committee formed at the spring meeting of Experimentalists at Harvard, of the Psychology Committee of the National Research Council, of the Committee on Fatigue of the National Committee of Defense, and of the Committee on the Classification of Personnel in the Army. I was chairman of the Committee on Vision and of the Committee on Psychological Instruction of the Psychology Committee, Psychological Consultant of the Training Section of the Bureau of Navigation of the Navy for the selection of listeners, and, at the end of the war, responsible for the psychological side of the Lookout School at New London as Lieutenant Commander, U.S.N.R.F. Naturally I was not equally effective in all these enterprises, but all were, I think, reasonably successful. I was glad of all the opportunities for national service but especially glad to be in the anti-submarine warfare which aroused me more

than any other phase of the war. One of the great moments of my life was when, after months of work as consultant, I found myself an officer of the U.S.N.R.F. for scientific service. I have a suspicion that my appointment transgressed many Naval traditions.[1]

Dodge carried heavy editorial responsibilities: Editor, *Psychological Bulletin*, 1904–1910; *Psychological Review*, 1910–1915; *Journal of Experimental Psychology*, 1916–1920; *Psychological Monographs*, 1927–1931; associate editor of *Journal of Comparative Psychology, Psycho-Biology* and *Journal of General Psychology*.

He had many responsibilities in learned societies, notably, the National Academy of Sciences, the National Research Council, chairman of the division of anthropology and psychology in 1922–1923, and American Psychological Association, president, 1916–1917.

His bibliography up to 1931 is published in the Psychological Register.[2] His autobiography appears in Volume I of the "History of Psychology in Autobiography."

In 1924 he went to Yale and associated himself with the psychological triumvirate—Dodge, Yerkes and Miles in the Institute of Human Relations, from which he retired in 1936.

CARL E. SEASHORE

RECENT DEATHS

DR. JOSEPH CHARLES ARTHUR, since 1915 emeritus professor of botany at Purdue University, died on April 30 at the age of ninety-two years.

DR. JOHN H. SKINNER, professor of animal husbandry and dean emeritus of the School of Agriculture of Purdue University, died on April 28 at the age of sixty-eight years.

SCIENTIFIC EVENTS

THE MARINE BIOLOGICAL STATION AT PORT ERIN

ACCORDING to the report of the acting director of the Marine Biological Station at Port Erin, work during 1941 was again determined by the continuance of war conditions. Visits by student classes have been rendered all but impossible by the ban on residence within the Port Erin Internment Camp of any but the permanent population of the village. Nevertheless, a number of postgraduate workers and one school class have been able to make use of the station's facilities, under police permit, while occupying rooms outside the camp area—a course recommended to other prospective workers. The closure of Port Erin to summer visitors has reduced the income from the aquarium to negligible proportions, so that this side of the work is being kept at care-and-maintenance level. Endeavor has been made, by cooperation with the Army Educational Scheme and in other ways, to render service to the members of H.M. Forces now in the island. There have been several organized visits by parties of soldiers, and the acting director has given numerous illustrated lectures, on marine and other topics, at two military centers. On the scientific side, the work of both staff and visiting research workers has been closely aligned with that of certain official and quasi-official investigations into (a) the reproduction and growth-rate of certain seaweeds of industrial importance, with a view to their rational harvesting, and (b) the further development, under war conditions, of the fishing potentiality of Manx waters.

More time than usual has this year been devoted to the library; a considerable overhaul has taken place, arrears of binding made good and an entirely new shelf-catalogue and an accessions register prepared. With the help of one or two assistants with experience in library work, the collection of separata on marine biological and hydrographical subjects, numbering several thousand papers, has been entirely reorganized.

In view of the continued deprivation of income from the public aquarium and from fee-paying students, the departmental grant of the university to the station, for the session 1941–42, has been increased from £150 to £200. A renewal for the same session of the grant-in-aid from H.M. Development Commission of £100 is also acknowledged.

STANDARDS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

THE Executive Committee of the American Society for Testing Materials has recognized the desirability of providing for prompt modification of standards during the national emergency and that some appropriate method be established in anticipation of necessary changes, particularly in specification requirements, due to possible rapid shifts in the available supply of materials under present conditions.

The procedure planned, as given in the *Bulletin* of the society, provides that

> in the case of certain metals and alloying elements, for instance, scarcity and the need of conservation for defense purposes might point to the need of modifying the usual

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[1] C. Murchison (Ed.), "History of Psychology in Autobiography," Vol. I, 1930, 99–121. Worcester, Mass.: Clark University Press.

[2] C. Murchison (Ed.), "The Psychological Register," Vol. III, 1932, 133–134. Worcester, Mass.: Clark University Press.

specified compositions of many alloys containing such critical materials, and of doing so more promptly than the regular procedure would permit. In fact, in most instances it will probably be found preferable not to change the standard itself but to provide for temporary optional requirements. Our regular procedure provides that a standing committee, after approval in its group, can refer to any time proposed tentative revisions of standards, new tentative standards or changes in tentative standards to Committee E-10 on Standards. While in this way reasonably prompt action can be taken with respect to desirable changes leading to formal revisions of a standard, a proposed emergency procedure is now offered our committees which is intended to expedite the approval and publication of emergency revisions of a temporary nature and at the same time provide adequate safeguards in their promulgation.

Revisions promulgated under this procedure are to be construed as representing optional requirements, to be introduced by the following expression: "Where it may be considered by the purchaser a satisfactory revision for the specific application or use desired."

Proposed temporary modifications shall first have the approval of the appropriate subcommittee of the sponsoring committee or duly appointed subgroup of that subcommittee and shall have the endorsement of the chairman of the main committee. The emergency revision shall then be submitted to Committee E-10 for approval for publication with the specification in question. If approved by Committee E-10, it will be published with the specification either in the form of a sticker or as an accompanying sheet and will also be published in the next succeeding issue of the *Bulletin*. Any emergency revisions approved during the year will be recorded in the next annual report of the standing committee. All such revisions will be subject to annual review and the standing committee shall annually report its recommendations with respect to them.

GIFTS AND BEQUESTS TO CORNELL UNIVERSITY FOR 1941

GIFTS and bequests to Cornell University during the fiscal year ending July 1, 1941, amounted to $2,261,037, according to the annual report of treasurer, G. F. Rogalsky. Of this amount $1,054,330 was added to the university's permanent endowment, which is now $33,871,539.

Gifts for current use included $384,024 for research and investigatorships, $100,000 toward an addition to the physical plant, $31,138 for departmental development, $26,736 for scholarships and loans and $119,604 for miscellaneous purposes. The balance is composed of non-endowment funds, of which some are specifically restricted as to use and others expendable at the discretion of the Board of Trustees.

The total includes $112,902 in current gifts from 7,220 alumni through the Alumni Fund Council, a record, both for amount contributed and number of contributors, unsurpassed since 1931. Cornell alumni also gave $37,903 during the year toward the university's program for developing athletic facilities.

The largest bequest, $508,573, came from the estate of James Parmalee, Cleveland real estate operator and financier, who was graduated from Cornell in 1876. Gifts from the Rockefeller Foundation for endowment, research and departmental development totalled $697,425. Of this sum, $600,000 was to endow the Department of Public Health and Preventive Medicine in the Cornell University Medical College in New York. The foundation also made grants for research in tuberculosis, amino acids, longevity, reflex behavior, maize stock, chemistry, physics and the history of the Far East, and for departmental development in public health, anatomy, drama, music and Russian language and literature. An additional $5,555 was received from the General Education Board for a project in critical thinking.

S. C. Johnson and Son, Inc., gave $56,500 toward the establishment of the Herbert Fisk Johnson professorship in industrial chemistry, and the Olin Foundation contributed $100,000 toward the development program of the School of Chemical Engineering.

Among the notable bequests received during the year were additions amounting to $76,280 to the John McMullen Fund for scholarships in engineering, bringing the total of this fund to more than $2,000,000; $49,644 and an art collection valued at $35,000 from the estate of Roger P. Clark, an alumnus of the university; $32,380 of an anticipated $100,000 from the estate of John A. Heim, a graduate of the Medical College in 1905, to be used for scholarships in the Medical College, and $31,392 from the estate of L. L. Seaman, $25,000 from the estate of Henry R. Ickelheimer, $21,678 from the estate of Mary Kerschner, $19,030 from the estate of Rollie B. Low, $13,829 from the estate of Mabel Estey Rose, $11,600 from the estate of Della S. Bishop and $10,000 from the estate of S. Wiley Wakeman.

Among the numerous grants for research were funds of $21,950 from the Josiah Macy, Jr., Foundation for research in neurology, pneumonia, senility, biotin, aviation and family health; $15,012 from the National Research Council for studies of student pilots, morphology, metabolism, visual fatigue, physiology, air-sickness, night blindness and other phases of medicine as applied to aviation, and $9,101 from the GLF Exchange for studies in freezing foods, dairy feed, poultry, phosphate, cereal breeding and legume inoculant.

Anonymous contributions of $18,000 and $20,000 and the sum of $10,000 from Stanton Griffis, a graduate in 1910 and a university trustee, were received to be added to endowment funds. The sum of $10,000 was received from the Ralph Hitz Memorial Fund to establish a scholarship in hotel administration.

THE NASHVILLE MEETING OF THE ELECTROCHEMICAL SOCIETY

AT the annual meeting of the Electrochemical Society, which was held at Nashville from April 15 to 18, two symposia were presented—one on "Electric Furnace Reactions," in charge of Dr. John D. Sullivan, of the Battelle Institute, Columbus, and the other on "Corrosion," in charge of Dr. R. M. Burns, of the Bell Telephone Laboratories, New York City. In addition to technical papers presented at the various sections, one morning session was devoted to "Electrochemical Research."

At the banquet on Thursday, President Raymond R. Ridgway spoke on "Crystal Gazing with War Time Illumination." The award of the Weston fellowship to William E. Roake was announced at the dinner. Mr. Roake will work on the glass electrode under Professor Malcolm Dole at Northwestern University. There was also announced the award of the "Young Authors" prize to Dr. Edward Adler, of the College of the City of New York, who recently received the doctorate of philosophy at Columbia University, for two papers that were presented at the Cleveland convention a year ago on "Photovoltaic Effect" and "Semi-Conductor Photocells and Rectifiers."

Officers of the society elected for the coming year are: *President,* E. M. Baker, University of Michigan; *Vice-presidents,* R. B. Mears, Aluminum Company of America, New Kensington, Pa.; J. A. Lee, *Chemical and Metallurgical Engineering,* New York City; and C. L. Mantell, United Merchants and Manufacturers' Management Corporation, New York City. Dr. Colin G. Fink, of Columbia University, is secretary of the society.

The next meeting will be held in Detroit from October 7 to 10.

THE NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences held its regular annual meeting at Washington in the building of the academy and the National Research Council on April 27 and 28.

The meeting was devoted entirely to matters concerning the present work of the academy, consideration of possible changes in its structure and operation, and with the election of officers and new members. There were no sessions for the presentation of scientific papers and no social functions, except a smoker for members on Monday evening.

Officers and new members of the academy were elected as follows:

Foreign Secretary (to succeed L. J. Henderson, deceased): Walter B. Cannon, Harvard Medical School.
Members of the Council: A. N. Richards to succeed himself; G. W. Corner to succeed C. A. Kraus.
Foreign associate: Robert K. S. Lim, Peiping Union Medical College.
Members of the academy:
Homer Burton Adkins, University of Wisconsin.
Lyman James Briggs, National Bureau of Standards.
Hans Thacher Clarke, Columbia University.
Ralph Erskine Cleland, Indiana University.
Charles Haskell Danforth, Stanford University.
Albert Einstein, Princeton, N. J., foreign associate of the academy since 1922.
Conrad Arnold Elvehjem, University of Wisconsin.
Michael Heidelberger, Columbia University.
John Gamble Kirkwood, Cornell University.
Paul Dyer Merica, 67 Wall Street, New York, N. Y.
Thomas Midgley, Jr., Worthington, Ohio.
Francis Dominic Murnaghan, the Johns Hopkins University.
John Torrence Tate, University of Minnesota.
Alfred Marston Tozzer, Harvard University.
Ernest Edward Tyzzer, Harvard Medical School.
Selman Abraham Waksman, Agricultural Experiment Station, New Brunswick.

SCIENTIFIC NOTES AND NEWS

The Herty Medal of the department of chemistry of the Georgia State College for Women at Milledgeville has been awarded to Dr. Townes R. Leigh, dean of the College of Arts and Sciences of the University of Florida, in recognition of "distinguished services as a teacher and of his research in plants and soil." At the presentation of the medal Dr. Leigh will make an address, entitled "The Spirit of Science."

Dr. Rudolph Matas, professor of general and chemical surgery emeritus at the Tulane University of Louisiana, has been presented with the Medal of Havana, the highest distinction conferred by that city, in commemoration of the anniversary of the birth of Dr. Carlos I. Finlay, of Havana, Cuba.

At a recent meeting of the Cleveland Medical Library Association a portrait of Dr. William E. Bruner, professor emeritus of ophthalmology at Western Reserve University, was presented to the association, and an alcove in the library was named for him.

Former students of Professor Arthur S. Watts, chairman of the department of ceramic engineering of the Ohio State University, honored him at the Ohio State Ceramic Alumni dinner in Cincinnati on April 22. At the dinner, which is held each year during the annual meeting of the American Ceramic Society, the establishment of the Arthur S. Watts Fund was announced. This fund, for which $1,400 has so far been received, will when completed be used as a scholarship or loan fund for students in the department of ceramic engineering at the Ohio State. Professor Watts was presented with a book containing letters of greetings, congratulations and appreciation from more than two hundred of his former students.

Among the recipients of honorary degrees conferred on April 26 at the graduation ceremonies of the University of Pittsburgh were Forest A. Foraker, professor of mathematics since 1912, and J. LeRoy Kay, curator of paleontology at the Carnegie Museum.

DR. PAUL D. WHITE, physician at the Massachusetts General Hospital, Boston, was elected president of the American Heart Association at the recent New York meeting.

OFFICERS of the Grinnell Naturalists Society elected at the annual meeting held at the University of California on April 11 are: *President,* Seth B. Benson, Museum of Vertebrate Zoology, University of California; *First Vice-president,* Robert T. Orr, California Academy of Sciences; *Second Vice-president,* D. F. Tillotson, California Division of Fish and Game; *Recording Secretary,* D. F. Hoffmeister, University of California; *Corresponding Secretary,* Thomas L. Rodgers, University of California; *Treasurer,* Frank A. Pitelka, University of California; *Council Members* (two-year term), C. A. Reed and John Davis, University of California.

MEMBERS of the faculty of Columbia University who will retire this year include Dr. Robert S. Woodworth, professor of psychology; Dr. James H. McGregor, professor of zoology; Dr. W. Benjamin Fite, Davies professor of mathematics; Dr. Horatio B. Williams, Dalton professor of physiology; and Dr. Ernest L. Scott, associate professor of physiology.

DR. J. B. S. NORTON, professor of plant pathology at the University of Maryland, a member of the faculty since 1901, plant pathologist and botanist at the Experiment Station, retired from active duty on April 1. He has been appointed professor emeritus and will continue his work in plant breeding and taxonomy and on the botanical herbarium of the university.

DR. SAMUEL H. MARON, of the Case School of Applied Science at Cleveland, has been promoted to an associate professorship of physical chemistry.

DR. ROYSE P. MURPHY, assistant professor of plant breeding and assistant in agronomy and plant genetics at the University of Minnesota and at the Experiment Station, has been appointed associate professor of agronomy and associate agronomist at Montana College and Station. He takes the place of Dr. A. M. Schlehuber, who resigned recently.

DR. F. R. IMMER, acting vice-director of the Experiment Station of the University of Minnesota, has been made vice-director. He will continue his work as professor of agronomy and plant genetics.

DR. JOHN S. KARLING, professor of mycology at Columbia University, has been granted a Bermuda biological fellowship for the study of chytrid parasites of marine algae.

DR. NOE HIGINBOTHAM has been appointed plant physiologist to conduct investigations with rice at the Beaumont Substation of the Texas Agricultural Experiment Station during the absence of Lieutenant C. E. Minarik. Dr. Higinbotham held a Seessel research fellowship in botany at Yale University during the past year.

DR. FRANK J. TONE, since 1895 president of the Carborundum Company, Niagara Falls, has retired from the presidency and has been elected to the newly established position of chairman of the board of directors.

DR. L. W. BASS, of the Mellon Institute of the University of Pittsburgh, has been appointed director of the New England Industrial Research Foundation, Inc. He will engage in a systematic study of the manufactures and industrial problems of the New England States. Special emphasis will be placed on wartime requirements and on the furnishing of technical information to small and medium-sized companies.

DR. FRANK P. CULLINAN, senior pomologist in the division of horticultural crops and diseases of the Bureau of Plant Industry, U. S. Department of Agriculture, has been appointed assistant chief of the bureau.

H. W. STRALEY, III, head of the department of geology at Baylor University, Waco, Texas, has resigned. At the end of the spring quarter he will become connected with the Eastern Exploration Company in the Appalachian and Interior oil and coal fields.

DR. GEORGE WILLIAM HUNTER, III, assistant professor of biology at Wesleyan University, has received a captain's commission in the Sanitary Corps, Medical Department of the Army. He is now stationed at the Army Medical School, Washington.

DR. J. S. POTTER, staff member of the department of genetics of the Carnegie Institution of Washington, Cold Spring Harbor, N. Y., has been commissioned a captain in the Army of the United States. He reported on May 5 at headquarters of the Army Air Forces in Washington. Dr. Potter has been granted leave of absence from the Carnegie Institution for the duration of the war.

DR. HARRY B. FELDMAN, of the Worcester Polytechnic Institute, is serving as captain in the Chemical Warfare Service at Edgewood Arsenal, Md.

MEMBERS of the National Patent Planning Commission set up by President Roosevelt are Charles F.

Kettering, *chairman,* Owen D. Young, Chester C. Davis, Edward F. McGrady and Frances P. Gaines.

A SPECIAL committee "to appraise the work of the American Standards Association and to propose a program of development and financing" was authorized at a meeting on December 10, 1941, of the board of directors. Members of the committee have now been appointed as follows: R. E. Zimmerman, president of the American Standards Association, *chairman;* S. Bruce Black, National Association of Mutual Casualty Companies; George S. Case, American Society of Mechanical Engineers; C. L. Collens, National Electrical Manufacturers Association; Howard Coonley, Manufacturers Standardization Society of the Valve and Fittings Industry; H. S. Osborne, of the Telephone Group of the association and *chairman* of the Standards Council; J. C. Parker, vice-president, Consolidated Edison Company, until recently a member of the board of directors and of the council of the association.

THE annual Mellon lecture of the Society for Biologic Research of the School of Medicine of the University of Pittsburgh was delivered on April 23 by Dr. Herbert M. Evans, Morris Herzstein professor of biology and director of the Institute of Experimental Biology of the Medical School of the University of California. He spoke on "Unsolved Problems in Anterior Pituitary Physiology."

DR. E. D. ADRIAN, F.R.S., professor of physiology at Cambridge, is giving a series of lectures under the auspices of the British Council in Buenos Aires.

THE Linacre Lecture of the University of Cambridge was delivered on May 6 by Sir Joseph Barcroft, emeritus professor of physiology. He spoke on "The Onset of Respiration at Birth."

A MEETING of the Optical Society of America will be held at the Massachusetts Institute of Technology, Cambridge, on July 20, 21 and 22. A special feature of this meeting will be a symposium of invited papers on fluorescence and phosphorescence. Sessions will also be held for the reading of contributed papers.

THE tenth annual Summer Conference on Spectroscopy and Its Applications, sponsored jointly by the Optical Society and the Massachusetts Institute of Technology, will also meet from July 20 to 22. Admittance will be by reservation as usual. Further information and tickets to the conference can be obtained from Professor George R. Harrison, Massachusetts Institute of Technology, Cambridge. Arrangements have been made to include the program of the Conference on Spectroscopy in the program that will be issued early in July for all members of the Optical Society.

THE American Association of the History of Medicine held its eighteenth annual meeting at Atlantic City on May 3, 4 and 5. The address of the president, Dr. Jabez H. Elliott, of Toronto, was entitled "Observation and Interpretation." Dr. Hugh H. Young, of the Johns Hopkins Medical School, gave an address entitled "Crawford W. Long: the Pioneer in Ether Anesthesia," in commemoration of the one hundredth anniversary of the first application of ether anesthesia.

DISCUSSION

THE METHOD OF CONGRESSIONAL APPORTIONMENT UNDER THE LAW OF 1941

PUBLIC LAW 291 (H.R. 2665), signed by the President on November 15, 1941, directs that future apportionments of representatives in Congress shall be made by the method of equal proportions.

This method, devised in 1921, sets up the following criterion of a good apportionment. Suppose an actual apportionment bill, allotting any given number of seats (say 435) among the several states, is before Congress for consideration; and suppose an attempt is made to improve the bill by transferring a seat from one state to some other state. *Such proposed transfer of a seat from one state to another state should be made if, and only if, the percentage difference between the congressional districts in these two states would be reduced by the transfer.*

For example, Arkansas has a 1940 population of 1,949,387, and Michigan 5,256,106. Under the method of equal proportions, Arkansas gets 7 seats and Michigan gets 17 seats, so that Michigan's district (309,183) is 11.02 per cent. larger than Arkansas's district (278,484). But if a seat were transferred from Arkansas to Michigan, giving Arkansas 6 and Michigan 18, the Arkansas district (324,898) would be 11.26 per cent. larger than the Michigan district (292,006). Since 11.26 is greater than 11.02, the transfer should not be made.

By following a short-cut process of computation, the Bureau of the Census prepares, after each decennial census, an apportionment table which is certain to satisfy the above test for every pair of states. But any dispute between two states can be settled immediately by a direct application of the test, the only data required being the populations of the two states directly concerned and the number of seats allotted to each.

An extensive Bibliography on Methods of Apportionment may be found in the *American Mathematical Monthly*, vol. 49, p. 115, February, 1942.

For the convenience of any one who may wish to reproduce the "short-cut process of computation" we append the working rule actually followed in the Bureau of the Census.

Given, the populations of the several states. *First,* assign one seat to each state (here 48 in number). *Second,* multiply the population of each state by a series of multipliers given in Table 1. The number of multipliers used for each state should be somewhat greater than the number of seats expected to be assigned to that state.

TABLE 1

MULTIPLIERS FOR THE METHOD OF EQUAL PROPORTIONS

k	Multiplier	k	Multiplier
		27	.0377 4257
2	.7071 0678	28	.0363 6965–
3	.4082 4829	29	.0350 9312
4	.2886 7513	30	.0339 0318
5	.2236 0680	31	.0327 9129
6	.1825 7419	32	.0317 5003
7	.1543 0335–	33	.0307 7287
8	.1336 3062	34	.0298 5407
9	.1178 5113	35	.0289 8855+
10	.1054 0926	36	.0281 7181
11	.0953 4626	37	.0273 9983
12	.0870 3883	38	.0266 6004
13	.0800 6408	39	.0259 7622
14	.0741 2493	40	.0253 1848
15	.0690 0656	41	.0246 9324
16	.0645 4972	42	.0240 9813
17	.0606 3391	43	.0235 3104
18	.0571 6620	44	.0229 9002
19	.0540 7381	45	.0224 7333
20	.0512 9892	46	.0219 7935–
21	.0487 9500	47	.0215 0662
22	.0465 2421	48	.0210 5380
23	.0444 5542	49	.0206 1965+
24	.0425 6283	50	.0202 0305+
25	.0408 2483	51	.0198 0295+
26	.0392 2323	52	.0194 1839

(In this table, $M = 1/\sqrt{[(k-1)k]}$; the entries may be verified by squaring, without extracting any square roots.) *Third,* arrange all the resulting products in a single list in order of size, beginning with the largest. This forms a "priority list," indicating the order in which seats (in excess of 48) shall be given out. *Fourth,* assign seats to the several states in the order thus indicated, until any desired total (say 435) has been reached.

As noted above, any dispute between two states can be settled without any knowledge of the technical process of computation, by direct application of the test.

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SOME OBSERVATIONS ON THE FEEDING HABITS OF THE OCTOPUS[1]

IN recent years much has been written pertaining to the feeding habits of marine animals and of the minute details of the mechanisms involved in the capture and ingestion of their food. These studies result from an appreciation of the fact that the fundamental relationship among different species of a community of animals is a nutritional one, and in order to better understand the ecological implications, it is essential to know how the animals as individuals are able to capture their food or to escape the enemies preying upon them. The type of food utilized in any specific case is determined (sometimes within narrow limits) by the type of feeding mechanism possessed by the organism. Animals capable of active locomotion must seek out biotopes which support their food and the density of the organisms preyed upon will be determined in large measure by the efficiency of the *catching apparatus* of the predator, which is thus a factor in the balance of nature.

A common method of capturing food is by means of netting or screening devices such as the fine bristles on the appendages of barnacles, copepods, etc., or the gill rakers of fishes or whalebone of baleen whales. These netting devices, owing to their sieve-like nature, function to *concentrate* finely divided and scattered planktonic food gathered from a large quantity of water. A study of the feeding habits of the octopus reveals an ensnaring device of quite different nature, since, though it functions to make a multiple catch, it is not designed to filter but rather to impound.

The commonly observed method of gathering food by the octopus is that of lying in wait or stealthily approaching and suddenly striking out at its prey with a tentacle and grasping it with the aid of the suckers. But in addition to this method, small prey such as shrimp and small fish which live among low-growing seaweeds on the bottom, and which possess great agility in escaping the predator, may be caught in larger numbers by throwing over them a canopy-like web formed by the loose extensible membranes of skin connecting the bases of the tentacles and extending for some distance along the sides of each. This method of feeding was observed in the field on several occasions for large specimens of *Paroctopus apollyon* near the University of Washington Oceanographic Laboratories at Friday Harbor, Washington, and in view of the apparent want of published records of similar observations, it is deemed worth a brief note at this time.

The fishing action consists essentially of four steps: (1) gliding stealthily forward over seaweed beds while three or more tentacles are extended forward and high off the bottom; (2) the upraised tentacles are then slowly arched, bringing the distal ends downward with almost imperceptible movement to the bottom where the end suckers presumably attach to the hard bottom; (3) when this has been accomplished the loose web of the tentacles is extended with incredible speed so that the membranes of skin between adjacent tentacles form a closed canopy or "net" under which the shrimp and fish lurking in the sea weeds are impounded; (4) now the canopy is gradually diminished in size by pressing the tentacles closer to the ground in such a manner that the catch is slowly forced inward towards the mouth. The whole process is then repeated, sometimes in quite rapid succession. One specimen kept under observation from a rowboat made fifteen "hauls" in twenty minutes. The method is sometimes modified somewhat to a more commonly observed one whereby the animal pounces forward upon the prey with a less extended canopy.

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[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 163.

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INFECTIVITY OF EXTRACTED, UNPRESERVED TOBACCO MOSAIC VIRUS RETAINED 28 YEARS

The extracted, unpreserved virus of mosaic-diseased tobacco may retain its infectivity for a long period of time *in vitro* under certain conditions.

On February 27, 1914, I set aside a portion of the original extracted virus of tobacco mosaic with which I was working at this time. This virus was used for studies upon which early papers were based, including, among others, "The Mosaic Disease of Tobacco"[1] and "Effects of Chemicals on the Virus of Mosaic Disease."[2]

A portion of the original virus, merely filtered through filter paper, was placed in a vial, tightly stoppered with cork, and kept on a shelf at room temperature since 1914.

This virus, tested in 1936, was found to be as infectious as when first extracted. It was again tested in 1942, by inoculating twenty small Connecticut Broadleaf plants, using the method of rubbing the virus on the glandular trichomes of the leaves on February 27. The first symptoms of mosaic were indicated on March 7 on nine plants, and the remaining eleven plants showed symptoms on March 9. Control plants had shown no symptoms several weeks later.

The pH of this original virus was determined at the time of testing in 1942 with a Beckman pH meter, using a glass electrode, and was found to be 6.76 or near neutral. These tests indicate clearly that this virus, although stored without preservatives at room temperature, was highly infectious 28 years later.

In "A Textbook of Plant Virus Diseases," by Kenneth M. Smith, 1937 (p. 232), it is stated that sterile, filtered juice retains its infectivity probably several years, but that ordinary extracted sap stored at room temperature soon becomes reduced in strength. The latter statement appears to be based upon the paper "Accuracy in Quantitative Work with Tobacco Mosaic Virus," by F. O. Holmes.[3] Holmes found a rapid reduction in number of infections in aging, undiluted and unpreserved virus stored at room temperature. His results would indicate a partial breakdown or denaturing of the infective principle, whereas this has been slight in the case of my 28-year-old virus.

Long ago I found that the degree of infectivity of such extracted, unpreserved virus would quickly decline, even to the point of becoming entirely innocuous, or the virus might remain highly infectious for years. In general, two types of fermentation appeared to occur, one resulting in acid conditions apparently very destructive to the virus, accompanied by a sour or acid and not unpleasant odor; the other with a near neutral reaction or low acidity condition favoring retained virulence, characterized by a most persistent and offensive odor.

Dried and ground leaf material obtained from mosaic-diseased tobacco on November 9, 1915, and stored in a jar at room temperature was no longer infectious in 1936.

These tests would indicate that the retention of virulence of extracted, unpreserved sap depends upon the type of fermentation which gains control under certain conditions.

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WEATHER FORECASTS

Among the *Science News* "Items" in Science for December 26, the one on weather forecasts gives a quaint little pat on the back to one of the most persistent and wide-spread of popular misconceptions about our atmosphere. It is that "The air is heavy with moisture" when it is likely to rain. Of course the notion is wrong in both of its two possible aspects: (1) because of the molecular weights of water and of the hydrogen-oxygen mixture. If all the molecules of water vapor in a given volume of saturated air were taken out and replaced by an equal number of air molecules, all other conditions being unchanged, the weight would be increased by something of the order of one per cent. Dry air is heavier than moist air. (2) When it is likely to rain the barometer is invariably low and therefore the weight of the whole atmosphere above a given area of the earth's surface is proportionally less than on a fine day when the barometer is ordinarily higher. Yet, if you try to get an average university student to understand these facts, he is very apt to simply look reproachfully or pityingly at you. If he has enough nerve he may tell you that every one knows that the air is heavy on a muggy day because you can feel it so. To him it is a question of psychology and not of physics. One is tempted to wonder what the writer of the news item feels about it.

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[1] *Bull.* 40, U. S. D. A., 1914.

[2] *Jour. Agric. Res.*, 13, 1918.

[3] *Bot. Gaz.*, 86: 66–81, 1928.

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SCIENTIFIC BOOKS

THE CEREBRUM

Emanuel Swedenborg. Three Transactions on the Cerebrum. Now first translated by ALFRED ACTON. Philadelphia: Swedenborg Scientific Association. Vol. 1, 1938. xxxiii + 731 pp. "Anatomical Plates" (bound as a separate volume, 175 pp., 148 figs.) Vol. 2, 1940. viii + 179 pp. $12.00.

EMANUEL SWEDENBORG entered the field of neurology with an essay "On Tremulation." He had studied Willis and Vieussens, but was under the spell of Baglivi's "De Fibra Motrice." Baglivi, working with Pacchioni, had seen the dura mater pulsate with powerful systole and diastole, and had called it the heart of the brain. The cerebral cortex, they agreed with Malpighi, consisted of minute glands which extracted a nervous fluid from the blood and discharged it through excretory vessels that made up the white or medullary substance. Thence the nervous fluid was sent through the peripheral nerves to all parts of the body, impelled in the twinkling of an eye, with the velocity of light, by the contractions of the dura mater. Every one knows, says Baglivi, how swiftly a sensory impression made by external objects is conveyed to the mind's chief domicile, the cerebrum; and he discusses the transmission of *oscillations* through solids and through liquids.

For Swedenborg the oscillations are *tremulations*, and life (audition, vision, every sensation and motion) consists of these little vibrations—stillness and rest is death. Impacts from without are received by the cuticle, "which is nothing but a ramification of nerves," and are conveyed centrally along the nerve sheaths which are extensions of the dura mater. "The meninges produce a continuous system of membranes over the whole body." "The dura mater," for example, "applies itself closely to the bones," sending little tendons or threads far into their substance. Bone and periosteum are good transmitters, as are other membranes save when slack, so that reception, spreading like lightning through connective tissue misinterpreted as nerve, is diffuse; yet in the meninges "reside the most subtle sensations."

Outgoing tremulations in the nervous fluid follow the nerves into "finer and finer branches until they are finally expanded into membranes," and the circuit is complete. The fluid distilled into the medullas flows "through the nerves into the membranes and then back again to the medulla, making a circulation similar to that of the blood." Fear, with low blood pressure and therefore slack membranes, prevents transmission of the nervous fluid and paralyzes. In telepathy one's membrane "trembles from the tremulation of the other person's cerebral membranes, just as one string is affected by another, if they are tuned in the same key."

With visions of a new neuropathology, Swedenborg published in briefest note nine "rules" of tremulation (1718), and prepared a manuscript on that subject which he handed to the Royal Medical College a year later. The Board of Health (Sundhets Collegium) to whom it was referred for an opinion, passed it around and lost it; Swedenborg did not preserve the original draft, and all that remains of it is indeed the essential part, which he had sent with interesting letters, to his brother-in-law, librarian of the University of Upsala.[1]

For the next 15 years Swedenborg was occupied "exclusively with mineralogical and metallurgical studies," which led to his *Opera philosophica et mineralia* (Leipzig, 1734, 3 vols., fol.). Then he returned to neurology, reading and copying excerpts from nearly all the standard texts. In 1734 he published also "De Infinito," or, in its English translation, "The Philosophy of the Infinite,"[2] in which he considers the relation of soul and body, and concludes: "The soul resides particularly in the cortical substance of the cerebrum, and partly also in the medullary, where exquisitely subtle membranes can run connectedly from particle to particle, likewise above, around and within every particle of the above substance." This idea of the prime importance of the cerebral cortex was not new. Willis (1664) had said that the reason for the duplex substance of the cerebrum appears to be that the cortical part exists to *produce* the "animal spirit," and the medullary portion to distribute and utilize it. Varolio (1573) in colorful lines had declared the white substance of the cerebrum to be the mirror of the intellect and servant of the mind, since he considered the gray layer merely as white discolored through its great vascularity.

Captivated by neurology, Swedenborg in 1736, at the age of 48, obtained leave of absence for travel and intensive study in that field. He spent a year and a half in Paris, presumably frequenting Dr. Petit's School of Chirurgery, and went on to Venice, where, in 1738, he completed the manuscript which forms Volume 1 of Dean Acton's translation. Volume 2 consists of the “Amsterdam additions” thereto (1740). His plan was to copy whatever had been published on a given topic that seemed to him significant, here presented under the caption, “Anatomical Experience,” and then to write his “Inductions” therefrom. Anatomy and Induction thus alternate through the volume, on 31 major topics, with an interruption of 10 pages to state that it is inadvisable to consider the brain piecemeal, and to define “animal spirit.” We are told (p. 422) that “the cerebrum as affirmed by Hippocrates, Malpighi and others is the most perfect of all glands: that nowhere else can the marvellous nature of glands be explored to better purpose.”

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[1] "On Tremulation," by Emanuel Swedenborg. Translated by C. Th. Odhner. Boston [1899]. xiii + 79 pp. (This includes parts of the letters, the entire publication of 1718, and all that remains of the 1719 MS.)

[2] Outlines of a philosophical argument on the infinite, and the final cause of creation and on the intercourse between the soul and the body. Transl. from the Latin by J. J. G. Wilkinson, London, 1847. xxx + 160 pp. Reprinted as "The Philosophy of the Infinite," Boston, 1848. 64 pp.

The importance of Swedenborg's neurological studies is not so much from observations of his own, as from an uncanny appreciation of what was sound in the literature, especially the recent literature. He has perhaps overstated this in a remarkable passage in his “Oeconomia regni animalis,”[3] abbreviated as follows (Clissold's translation, Vol. 1: p. 7–8):

> In the experimental knowledge of anatomy our way has been pointed out by men of the greatest and most cultivated talents, such as Eustachius, Malpighi [and 18 more whom Swedenborg names]; whose discoveries, far from consisting of fallacious, vague, and empty speculations, will forever be of practical use to posterity. . . . There are others again who enjoy a natural faculty for contemplating facts already discovered and eliciting their causes. Both are peculiar gifts and seldom united in the same person. Besides, I found that as soon as I discovered anything that had not been observed before, I began (seduced probably by self-love) to grow blind to the research of others . . . [warping and twisting other phenomena into conformity with my supposed invention]. I therefore laid aside my instruments, and restraining my desire for making observations, determined rather to rely on the researches of others than to trust to my own.

With the scalpel and probe, Swedenborg also laid aside his pencil, for we have apparently only one neurological drawing that he made—a simple figure of his dissection of a duck's brain in dorsal view, to show the “innumerable” twigs between the cerebral artery and the sagittal sinus.[4]

With neither pictures nor descriptions of his own work, it is often difficult to distinguish Swedenborg's original observations from speculations and quotations. For example, as to the finer vessels of the cortex, he writes (p. 22–23):

> From the experiences adduced it seems inferable to some extent that the cortex, so called, is the noblest substance of the brain, the individual parts whereof are woven of arteries which have terminated in the most delicate threads. . . . What specifically that tunic is, which by means of arteries is transmitted to the spherules of this cortical substance is a matter that can not be explored by help of the senses. From various signs, however, it would seem possible to conclude that it is the *inmost tunic of the arteries*. These arteries when they enter the cerebrum always relinquish their outer coat and also their muscular, while the inner coat is continued even beyond the meninges; and this conducts the purest blood into the cortical substance itself, and thence into the fibrils. This will be further confirmed in the Transactions on the Arteries of the Brain.

Worthy of a Nobel prize! Since all vessels at first are endothelial *intima* and nothing more, and all perfected vessels are but this intima covered by accessory coats which are gradually lost on approaching the capillary ramifications, Swedenborg here seems to have experienced a revelation. Yet what in fact is visible with a good microscope, he declares can not be seen. Willis, who had attempted to picture and describe this intima, had no such comprehensive idea of it. But Swedenborg in that later reference (p. 236–7) rather spoils it all by saying that the vessels of the whole cerebrum are in no way ruled by the heart and vagus nerve—“the internal carotid artery puts off its muscular and other tunics and *puts on tunics wholly different,* to wit, a membranous tunic borrowed from the dura mater, and a filamentary or reticular tunic borrowed from the sympathetic nerve: it retains, however, its own inmost tunic.” Histologists know nothing of this change of coats. Elsewhere (p. 283) Swedenborg describes the intercostal nerve and par vagum, not as alternatives or antagonists, but in close companionship in the vessel wall, “so that the artery or vein knows not by what motory it is caressed.” The nerve enters the vessel wall “in a friendly fashion and nowhere is dissension to be seen.”

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[3] Swedenborg, E. Oeconomia regni animalis in transactiones divisa. 4to Pt. I, Londini et Amstelodami, 1740. Pt. II, Amstelodami, 1741. [Swedenborg's ‘‘regnum animale’’ is not Cuvier's, since ‘‘animalis’’ here means ‘‘pertaining to the soul.’’] The Economy of the Animal Kingdom, considered anatomically, physically and philosophically. Parts I and II. Translated by A. Clissold. London and Boston, vol. 1, 1845: vol. 2, 1846. Also, 2 vols. Boston, 1868; also (the ed. here cited) New York [1903] vol. 1, 564 pp.; vol. 2, 432 pp. (See ‘‘A Bibliography of the Works of Swedenborg’’ by James Hyde. London, 1906. xvii + 742 pp. 3,500 items.) Part III, transl. by A. Acton, Philadelphia, 1918. lxii + 385 pp.

[4] The Economy of the Animal Kingdom, Vol. 2, p. 94. No figure by Swedenborg accompanies Dean Acton's ‘‘Three Transactions’’ but an unnumbered, unpaged volume of ‘‘Anatomical Plates’’ has been provided, selected from 20 of the authors cited by Swedenborg. The plates, with explanations conveniently opposite, are arranged alphabetically by authors, from Bartholin to Willis. Malpighi, with 26 pages of pictures, chiefly of the chick, is perhaps predominantly represented. There are 21 pages of Vieussens' plates, 14 from Willis, 8 from Ruysch, etc.—an instructive assemblage of curious old drawings.

Swedenborg also had glimpses of a neuron theory, built upon Malpighi's observation of "glands" in the cortex, which were presumably groups of cell bodies. Leeuwenhoek had seen the smaller individual "globules," none too clearly distinguished from droplets of myelin and other debris. Swedenborg stated that there was no "scarcely visible spherule of the cortical substance" that does not "bring forth a fibre as its own proper path of determination";—"the beginnings of the fibres are indeed as many in number as are the spherules of this substance." Thus he anticipated the demonstration of neuraxons. Dendrites he less clearly adumbrated in the capillaments too fine for red blood to enter, which connect the vessels with the spherules. Each spherule which thus receives and discharges is a "brain in least effigy"—a "cerebellulum."

Swedenborg's recognition of motor areas in the cortex is the acme of these divinations, accounted by Gustaf Retzius, in his presidential address before the Anatomical Congress of 1903, not merely as "recht merkwürdig" but as "wunderbar" and "erstaunenswert."[5] For Swedenborg not only knew that such centers existed, but "on the whole he correctly described their location,"—that for the leg above, trunk in the middle and head below, in the anterior portion of the hemisphere, being related to the body "in an inverse ratio." The historian Neuburger was profoundly impressed.[6] Ramström, seeking to account for this "work of genius," believes that pathological cases, combined with pictures and findings of Vieussens, were the source of Swedenborg's conception.[7] But, as the present reviewer has noted, when Swedenborg declares that the determination of what convolution corresponds with this or that muscle of the body can be made only "per experientiam in vivis animalibus, per *punctiones, sectiones* et *compressiones*" he recommends a succession of procedures that he learned from Baglivi. The latter studied the nerve sheaths in living animals "*vario punctis, resectis, affectisque.*"

Retzius intimates that Swedenborg discovered the central canal of the cord and the cerebro-spinal fluid. An easy reference to Burdach would have shown that the central canal was found by Estienne (1545) and that Columbus, Piccolomini, Bauhin and Malpighi had considered it normal; moreover, Swedenborg merely surmised its existence. The cerebro-spinal fluid, as the reviewer finds, was known to Coiter in its usual thin and occasionally thickened condition (1573). Whatever is new in Swedenborg is not labeled as such, and often is buried in fiction and romance, not always "lustrous with points and shooting spiculae of thought":—"The pons is the bed or conjugal chamber or couch for both the brains; for there like a pair of consorts, they join their first embraces and enter into a common covenant for the conception and bringing forth of their nerves."

Swedenborg has made a long story of his progressive study of the brain, nearly all of which is now available in English, included in the following works. On Tremulation, 79 pp.; The infinite, 160 pp.; Three Transactions, 2 vols., 910 pp.; Economy of the Animal Kingdom, 3 vols., 1,381 pp.; The Brain, 2 vols., 1,439 pp.; Animal Kingdom, Part 3, 226 pp. Even when Swedenborg tore vertically in halves eight pages of Latin manuscript and threw one half away, the missing portion has been conjectured and added so that not a line be lost. It remains for some neurologist to discard the quotations, repetitions and revisions, and present Swedenborg's contribution in a form that does not require a Swedenborg research on the part of every reader. For it is clear that Swedenborg deserves an honorable place among the "Apostles of Physiology"—a place that too often has been denied him. Essential for this undertaking are the Three Transactions, now made available by Dean Acton, through his scholarly and devoted labor, in the highly commendable volumes here inadequately reviewed.

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REPORTS

STATEMENT OF CONDITIONS OF THE AMERICAN CHEMICAL SOCIETY

THE American Chemical Society is still growing in numbers, in prestige and in influence, far more so than some of us who have been in closest touch with its progress had any reason to hope. It simply means that American chemists are more and more realizing that the American Chemical Society is their friend, is interested in their welfare, is doing all it can to enable them to develop themselves, and that membership in the society is a catalyst to success. Its efficacy is not always appreciated by individuals who lack real professional consciousness.

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[5] "Emanuel Swedenborg als Anatom und Physiolog auf dem Gebiete der Gehirnkunde." *Verh. d. Anat. Ges.*, pp. 2–14, 1903.

[6] Dr. Max Neuburger. "Swedenborg's Beziehungen zur Gehirnphysiologie." *Wiener Med. Wochenschr.*, Jahrg. 51, col. 2077–2081, 1901.

[7] Martin Ramström. Emanuel Swedenborg's investigations in natural science, and the basis for his statements concerning the functions of the brain. Kungl. Vetenskaps-Societet., Uppsala, 1910, 59 pp., fol.

The society now has 30,400 members, of which slightly over 3,000 have joined in 1942. There has been a loss of approximately 1,000 subscribers to the *Journal of the American Chemical Society;* 1,200 to *Chemical Abstracts;* 1,600 to *Industrial and Engineering Chemistry;* and 1,400 to *Chemical and Engineering News,* in foreign countries to which publications can no longer be sent and from which payment can not be received. In spite of this, on April 1, 1942, the *Journal of the American Chemical Society* had 60; *Industrial and Engineering Chemistry* 431; and *Chemical and Engineering News* 1,481 more subscribers than on April 1, 1941. The subscription list of *Chemical Abstracts,* on the other hand, has, on account of large foreign circulation, decreased 342 between these two dates. Income from subscriptions, since the increase was largely due to subscriptions at the special rates given to members, is so far approximately $7,000 less in 1942 than in 1941 on the same date.

Some of the society's current specific accomplishments for its members, outside of normal procedure, are herewith brought to your attention.

The Committee on the Professional Training of Chemists has collected complete lists of the students in our colleges and has sent a special questionnaire to all these students for registry in the National Roster of Scientific and Specialized Personnel. At this time, the committee has been in session for four days and evenings, continuing its strenuous labors in studying and accrediting the chemical departments of our educational institutions. The society owes the members of this committee a debt of gratitude for accomplishments which are having, and will continue to have, a far-reaching effect on our professional standing and on the quality of the chemists and chemical engineers whose services are in future to be utilized by our country.

The Employment Clearing House is again functioning, and continues to give unusual opportunities to our members for contact with our best employers, thus rendering a service unsurpassed by any professional group. In order that those principles may be implemented, it is open only to employers who agree to the basic principles laid down by the Board of Directors in its action taken at Atlantic City on "Employer-Employee Relationships" (see *News Edition,* Vol. 9, p. 1014, September 25, 1941). A number of firms have written the society, stating that they were carefully revising their lists of employees to be sure that they met at least the minima set by the directors, and a number of firms have stated that they are, and have been, exceeding the recommendations for salaries to graduate chemists and chemical engineers. From the reports coming from our colleges, it is very evident that the young men being graduated this year are receiving distinctly higher offers of compensation than in previous years. Unfortunately, this is not true of all employers and explains in part the number of individuals registering for employment or change of employment in the Employment Clearing House. Practically all those registered are seeking change of employment, the number of unemployed registrants being negligible.

The American Chemical Society Committee on Cooperation with the National Defense Research Committee sent out a questionnaire last December, the results of which were embodied in the article, "The 'Production Army' *vs.* the 'Combat Army,'" which appeared in the February 10 *News Edition.* This, too, has had its influence on a desire for change of employment, but it has been especially helpful in convincing authorities directing the war effort that there is a very serious scarcity of chemists and chemical engineers for the "Production Army," and that replacements for any who may be inducted are almost impossible unless other serious vacancies are created.

Expenses for paper and printing are increasing, the directors having found it necessary to modify the society's contract with the Mack Printing Company to help meet additional costs forced upon the company in connection with labor and materials. Nevertheless, it is anticipated that with the increased support from American chemists we will again be able to balance our budget.

One of the society's most noteworthy accomplishments of the past year was the quite definite establishment of the full professional status of our members and the legal recognition of graduate chemists and chemical engineers as professional men. To-day, full membership in the American Chemical Society is a far better guarantee of professional standing and status than can be given by any state licensing board. Through the interest, encouragement and support given by the American Chemical Society to its members at the Shell Development Company in Emeryville, California, it has been legally established that professional men can not be forced to submit to inclusion in any organization controlled by heterogeneous groups of non-professional men. It is a decision of far-reaching importance to the chemical profession, as outlined in the article on page 165 of the February 10 issue of *Chemical and Engineering News.* The National Labor Relations Board decision, No. R-3245, and briefs containing a compilation of the laws governing these case matters, are available to groups of our members who may be threatened with coercion. All this was promised to the membership when the Committee on Economic Status was appointed. This committee has been exceedingly active, and its report presented at this meeting, which will be published in detail in *Chemical and Engineering News* and reprinted as a separate document, will bring much important and useful information to the chemical profession.

The secretary's office has been especially concerned with, and active in, problems affecting the proper allocation of chemists and chemical engineers in the country's war effort. It is quite definitely recognized and admitted that the normal place for chemically qualified men is in the "production army," for it is there that true patriotism requires them to serve. Without them, the combat forces simply can not be supplied with the materials and implements of warfare. On the whole, Selective Service has functioned efficiently. General Hershey and his corps of assistants are exceeded in efficiency and intelligence by no other group in the Army or Navy. The local boards are made up of patriotic citizens and, for the main part, of intelligent citizens. It would be surprising if all the 6,600 local boards contained men who were capable of judging the importance to the war effort of graduate chemists and chemical engineers. Many mistakes have been made. Several hundred chemists and chemical engineers, including some with seven years of training and additional years of experience, have been inducted into the Army and are now functioning as stretcher bearers, orderlies, pharmacists' clerks, and in other necessary occupations, but occupations in which high-school graduates could function with equal efficiency. As a consequence, their years of special training and experience are lost to the country. For reasons which no one can explain, there are apparently no channels in the War Department through which this man power can be assigned to chemical work, either in the production or combat armies. The situation is just as serious as if graduates of West Point were assigned to the ranks as privates. All efforts to remedy this situation have completely failed, in spite of the fact that the entire matter has been forcefully presented to high authority. In many instances, also, students of chemistry and chemical engineering have not been allowed to complete their courses, which procedure is certain to deplete future supply should the war continue. These mistakes, however, have been caused by a few of the local boards only, and are not the rule. When appeals are properly made, and when details can be sent in time to Selective Service Headquarters, deferment for service in the "production army" is usually secured. Once inducted, the best trained chemists and chemical engineers are simply "genus homo" and at present nothing can be done toward utilizing their qualifications in the country's service.

In contacting local boards, employers should call attention to Selective Service Memoranda I-347, I-398 and I-405. If the men who have been called in the draft are necessary men in work essential to the national health, safety and interest and to the war effort, the employer should make every effort to see that deferment is allowed. If the local board refuses, the case should be immediately appealed to the Appeal Board. When an appeal is taken but not before, if the employer will send to the secretary's office a copy of Form DSS 42A used in the appeal together with the selectee's number and local board number and address, the case will be referred to Selective Service Headquarters in Washington for such advice and recommendation as the premises may warrant. Such appeals, when justified, have usually been granted. Eliminating previously mentioned errors, chemists and chemical engineers of America, with the exception of the group brought into the Army through their commitments as reserve officers, are serving the nation's war effort where they feel they can serve best.

The American Chemical Society has to-day a list of 60,000 individuals who, at least, believe themselves to be chemists or chemical engineers with data as to the training and experience of each. It has been of inestimable value to the society, and has greatly helped to implement its aid to both the production and combat armies.

CHARLES L. PARSONS,
Secretary

SPECIAL ARTICLES

SOME PRECOCIOUS DEVELOPMENTAL CHANGES PRODUCED BY ADRENAL CORTICAL HORMONES

THE more important functions ascribed to the adrenal cortical hormones are their ability (a) to maintain life, (b) to maintain at normal the carbohydrate levels in the tissues and (c) to maintain at normal levels the sodium, potassium and water balance in adrenalectomized animals. On the other hand, excessive amounts of these hormones may be presumed to be present in patients with adrenal cortical tumors, who may show marked bodily changes, the most pronounced of which are modifications of the sexual characteristics. These are attributed to the endocrine secretions of the tumor, among which have been identified several of the sex hormones (Reichstein, Kendall). When these tumors occur in fully grown adults, it is difficult to delineate changes other than those upon the sexual functions. However, in a case reported by Fraser,[1] an adrenal cortical tumor in a one-year-old male child not only resulted in precocious development of the secondary sexual characteristics but also in precocious skeletal and dental growth. The epiphyses at one year were similar to those in a five-year-old child and the dentition was that of a three-year-old child. These changes may be due to the sex hormones alone, to the adrenal cortical hormones alone or to a combination of these.

The purpose of the present report is to record the changes produced upon newborn rats by certain of the adrenal cortical hormones during the period when the greatest postnatal developmental changes normally occur.

Over 200 newborn albino rats of the Sherman strain were employed. Experiments were performed in which either desoxycorticosterone acetate (DCA)[2] in sesame oil or commercially available aqueous adrenal cortical extracts[3] were injected subcutaneously. These rats were controlled by injections of equivalent amounts into litter-mates of either sesame oil or Ringer's solution. The sexes were about equally divided in the experimental and control groups. A group of 32 newborn rats was observed during the same period, but the rats received no injections whatever. The DCA was injected in daily doses of 0.25 or 0.50 mg and the adrenal cortical extracts in daily doses of 0.1 to 0.6 cc. Within the first 24 hours of life, the preparations, especially DCA, proved toxic and resulted in a high mortality. However, when the injections were begun after the first day, there was no evidence of toxicity and no consistent difference was noted on the body weight between the hormone-injected and the corresponding control litter-mates. Hair growth, determined merely by gross observation, was uninfluenced.

In the hormone-injected rats the incisor teeth erupted approximately on the ninth day of life, which was always about 24 hours earlier than in the control litter-mates. Two to 3 days later the lower lip could be separated easily from the adjacent gingiva, revealing a large extent of the incisor teeth. At this time the lips of the control litter-mates were not as well developed and still firmly attached.

The eyelids of the baby rats began to separate at approximately two weeks of age. The eyes of the hormone-treated rats invariably opened 1½ to 3 days before those of the litter-mate controls. It was quite striking to see the hormone injected baby rats with eyes wide open, when the eyelids of every one of the litter-mate controls continued tightly sealed.

The precocity, as evidenced by the advanced eruption of teeth and opening of the eyes, is based on gross observation. It is believed that many other changes may be taking place which require more detailed study.

Growth hormone, the sex hormones and some other substances which have been injected into baby rats did not influence the time of eruption or of eyelid opening. These experiments will be detailed in a more complete communication.

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LACTATIONAL PERFORMANCE AND BODY WEIGHT*

FIGURE 1 shows the relation of milk-energy production to body weight in mature animals of different species: dairy cattle (average of 368 "good" cows), dairy goats (average of 7 "good" goats) and white rats (average of 5 excellent rat mothers).

The data are generalized by the equation $Y = aW^b$ in which Y represents milk-energy production and W body weight.

The value of b, the slope of the fitted line on the logarithmic or percentage grid, is about 0.7: the differential percentage increase in milk-energy yield is 0.7 as rapid as the corresponding percentage increase in body weight; increasing body weight 1 per cent. increases milk-energy yield 0.7 per cent.

The precise numerical value of the slope b varies with the relative "dairy merit" of the animals. The significant fact is that milk-energy production tends to vary with W^b and the value of b is 0.7 ± 0.1.

This is significant because the minimum maintenance cost (basal energy and endogenous nitrogen metabolisms), weights of neuro-endocrine organs, cross-section areas of the circulatory and respiratory vessels, circulation and ventilation rates, external and nutritive and excretory surfaces vary in similar manner.[1] These percentage parallelisms bring out a fundamental unity in apparently diverse structures and functions.

The fact that these structures and functions tend to vary with $W^{0.7}$ rather than with $W^{1.0}$, might have been inferred from geometrical and mechanical considerations. Geometrically viewed, surfaces tend to vary with $W^{2/3}$; mechanically viewed, the pull of gravity varies with $W^{1.0}$ while the strength of the supporting structures tends to vary with $W^{2/3}$ (that is, with the cross-section areas of the supporting structures); hence, to retain stability the supporting structures must grow more rapidly than the visceral organs, or the visceral organs must grow less rapidly than the body as a whole, approximately in proportion to $W^{2/3}$; and it is the metabolism-supporting visceral organs *and nutritive and excretory surfaces that condition and limit the functional rates:* basal metabolism, apparently milk-production, and perhaps all vital and productive processes. If the small and large animals were similar and if the body did not develop devices for partial compensation of these geometric and mechanical limitations, the slopes of the curves relating these structures and functions to total body weight could be predicted precisely from geometric and mechanical considerations; since, however, small and large animals are not similar geometrically, mechanically or temporally, the value of the slope *b* in Fig. 1 for lactation, and for related structures and functions, can not be predicted precisely, but it may be said to be of the order of 0.7 ± 0.1.

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[1] I. Fraser, *Brit. Jour. Surg.*, 27: 521, 1940.

[2] Kindly supplied by Ciba Pharmaceutical Products, Inc., and Roche-Organon, Inc.

[3] Three preparations of aqueous adrenal cortical extract were used. One was kindly supplied by the Upjohn Company. We are also indebted to Mr. L. Caplan, of the Comptroller's Office, Inspection Division, City of New York, for a generous supply of Eschatin and of Wilson's Adrenal Cortex Extract.

* Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 822.

[1] *Univ. Missouri Agr. Exp. Sta. Res. Bulls.* 328 and 335, 1941.

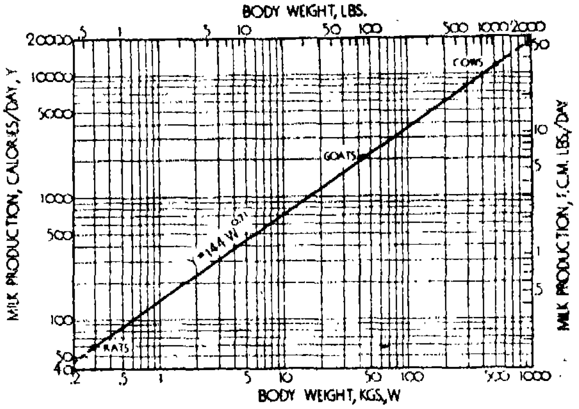

FIG. 1

The observation that *minimum* maintenance cost (basal metabolism) and milk production follow a parallel percentage course with increasing body weight suggests an economic application. If the *total* maintenance cost likewise parallels milk production with increasing body weight, the gross energetic efficiency of milk production (ratio of milk-energy produced to digestible feed-energy consumed) should be independent of body weight[2]; and if it is, the monetary profit of milk production should rise with increasing body weight because a major part of the expense of commercial milk production is for the labor of milking, feeding, cleaning, bookkeeping, housing, and so on; and such labor per animal is, within the species at any rate, practically the same whether it be relatively large or small. Hence, *within a given gross energetic-efficiency class,* the larger the animal the less the labor cost per unit milk-energy produced and, *if other conditions are equal,* the greater the profit per unit milk produced, and still greater per animal and per herd.

Unfortunately, it is not known how total maintenance cost varies with increasing body weight. It may rise more steeply than basal metabolism because the energy cost of moving the body is directly proportional to $W^{1.0}$ rather than to $W^{2/3}$. However, the voluntary movements may decline with increasing weight in such manner that the total maintenance-energy cost parallels the basal metabolism cost. Thus large animals appear to make fewer and slower movements than small, and the energy expenditure at approximately physiologically-equivalent work levels parallels the basal-metabolism energy in 1,500-pound horses, 700-pound ponies, and 150-pound men.[3] The data in Fig. 1 do not throw convincing light on the maintenance problem. The gross energetic efficiencies of milk production in the small animals in Fig. 1 were higher than in the large[4]: cows 31 per cent., goats 35 per cent., and rats 44 per cent. These differences may be fortuitous, but they may also indicate that total maintenance-energy cost rises more steeply with increasing body weight than milk-energy production, due either to selection factors or to physico-chemical inter-relations having a similar effect.

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EFFECTS OF Ca AND OTHER DIVALENT IONS ON THE ACCUMULATION OF MONOVALENT IONS BY BARLEY ROOT CELLS

THE concept of antagonism holds that Ca and other divalent cations retard the entrance of monovalent ions like K and Na into the plant cell. The experiments upon which this theory is based were, in general, performed with high and often toxic concentrations of salt on cells or roots with little regard to their metabolic status.

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[2] There is no reason for assuming that it takes different amounts of feed-energy to produce unit milk-energy in, for example, 800- and 1,600-pound cows if the maintenance cost is excluded from the computations (*net* efficiency). If the maintenance item is included, the ratio of milk-energy produced to total feed-energy consumed (*gross* efficiency) is the same if the ratio of milk-energy produced to maintenance-energy is the same in large and small animals. If, however, the maintenance-energy rises more rapidly than milk production with increasing body weight, the gross efficiency decreases with increasing body weight.

[3] *Univ. Missouri Agric. Exp. Sta. Res. Bull.* 222 and 244.

[4] *Id., Res. Bull.* 285 and 291.

Recent investigations on the absorption of K and Br by actively metabolizing excised root systems of barley like those used by Hoagland and Broyer[1] showed that Ca and other cations appreciably increased the rate of absorption of K and Br as shown by analysis of sap expressed from previously frozen roots. Data from a typical experiment of 10 hours duration are shown in Table I.

TABLE I

Solution	Absorption in milliequivalents per liter of sap	
	K	Br
.005N KBr	24.7	15.9
.005N KBr + .001N $CaSO_4$	28.6	23.5
.005N KBr + .005N $CaSO_4$	30.9	24.8
.005N KBr + .025N $CaSO_4$	37.2	30.1

Potassium absorption from KNO_3 and K_2SO_4 solutions was also increased by Ca.

In several experiments it has been found that Ca may increase K absorption by 80 and Br by 100 per cent. without affecting the rate of CO_2 production.

Barley roots responded to Ca during simultaneous K and Br absorption regardless of their initial Ca content. Roots grown in the preliminary period in nutrient solutions saturated with $CaSO_4$ responded fundamentally the same as roots grown at lower Ca levels when subjected to study over a subsequent experimental period. Pretreatment of roots for 4 hours in saturated $CaSO_4$ solution produced no change in the rate of K and Br influx from dilute KBr solutions as compared with control roots kept in distilled water during the pretreatment period.

Roots maintained at several controlled temperatures from 10° C to 30° C all responded to the presence of Ca in the solution by increased rates of K and Br absorption.

Calcium was always more effective than Mg and Mg more effective than Sr of like concentration in increasing the absorption of K and Br. Ba produced effects which depended upon the concentrations used, dilute solutions producing increases in K and Br absorption and more concentrated solutions producing decreases. Mixtures of Ca and Mg sulfates produced increases in salt absorption of the same general magnitude as did these salts used singly. This indicates that Ca and Mg are not performing independent functions but are performing some common function, Ca being more efficient than Mg.

These results suggest the possibility that Ca and kindred cations can increase the permeability of the plasma membrane to K and Br during concurrent salt accumulation.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

USE OF COMPLETE FERTILIZERS IN CULTIVATION OF MICROORGANISMS

SOMETIMES experimental work requires the use of very large quantities of a culture containing microorganisms. For example, in the studies conducted by the authors on the physiology of feeding of oysters as much as 90 gallons of a rich culture of plankton were needed every day for a period of several weeks. Obviously it was impractical and virtually impossible to grow such large quantities of microorganisms by employing standard laboratory technic and using a culture medium such as Miquel's. Therefore, a different method was sought. A large number of commercial fertilizing mixtures were tried, and several of them gave excellent results.

The use of various fertilizing substances in fish ponds and small lakes has long been practiced in Europe. Recently a number of American workers, notably Wiebe[1] and Swingle and Smith,[2] contributed to our knowledge on the use of fertilizers in increasing the fish production of small bodies of fresh water. As a rule, after the addition of fertilizers, a significant increase in phytoplankton occurred. This in turn was followed by a prolific growth of zooplankton.

The fertilizing mixtures used in our studies are known as complete fertilizers. They are usually designated by a formula such as 5-3-5; 6-3-6; 10-6-4, etc., which indicates percentages of compounds of nitrogen, phosphorus and potash. Many of these fertilizers contain large quantities of organic components such as cottonseed meal, castor pomace, soyabean meal and steamed bone meal. There are also traces of copper, zinc, manganese, boron, iron and some of the other elements. Of the numerous mixtures tried the fertilizers 5-3-5 and 6-3-6 gave the best results. Both these fertilizers are used by tobacco growers. The relative value of each fertilizer was determined in a series of controlled laboratory experiments of growing cultures of *Chlorella* and *Nitzschia* in media prepared from each fertilizer.

For laboratory work a medium containing 1 gram of fertilizer in 1,000 cc of filtered sea water always gave excellent results. In growing *Nitzschia* and

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[1] D. R. Hoagland and T. C. Broyer, *Plant Phys.*, 11: 471–507, 1936.

[1] A. H. Wiebe, *Bull. Texas Game Fish and Oyster Comm.*, 8: 1, 1935.

[2] H. S. Swingle and E. V. Smith, *Trans. American Fish Soc.*, 68: 126, 1939.

Chlorella this concentration very often gave better results than when Miquel's solution was employed. Concentrations 1:5,000 and even 1:10,000 were also found satisfactory. In preparing a medium a comparatively large quantity of fertilizer should be ground, and from it the needed quantity taken and placed in the water. This will insure relative uniformity of the samples. When very large quantities of fertilizer are used, as is often the case in field experiments, no grinding is necessary. Using these fertilizers, exceedingly rich cultures of *Chlorella, Nitzschia closterium* and *Prorocentrum triangulatum* were grown in large outdoor tanks having the capacity of several thousand gallons. In addition to the forms mentioned above many other microorganisms were successfully grown in our media under laboratory conditions and in the outdoor tanks. Chlorophyll-bearing and colorless flagellates grew exceptionally well, while Ciliates such as *Colpidium, Glaucoma* and *Paramecium* produced good cultures.

There are several advantages of using complete commercial fertilizers for maintaining stock cultures in the laboratory and for growing mass cultures of microorganisms under field conditions. In the first place, the method is very simple, consisting of only one step of adding one gram or less of the fertilizer to a liter of sea or fresh water. Secondly, some of the substances composing the fertilizers enter into solution almost immediately, thus providing nutritive materials for newly started cultures. Its other components, however, require different periods of time before they are converted into the substances which can be utilized by the cultured organisms. Because of such a delayed but continuous supply of nutritive materials the cultures remain viable and active for many months, thus eliminating the necessity of frequent transfers for the maintenance of stock cultures. Cheapness of the material used in the method is another important advantage. One pound of fertilizer costing from 3 to 5 cents is sufficient for making almost 500 liters of culture medium.

It is thought that the suggestions offered in this brief article are especially pertinent at this time. Because of the war condition it is becoming more difficult to buy the chemicals usually needed in the preparation of solutions for the cultivation of microorganisms. Some of the ingredients may not be available at all. Therefore, the use of commercial fertilizers, which at present are easily obtainable, may solve the difficulties of many investigators.

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AN INEXPENSIVE, QUANTITATIVE PUMP

THE apparatus shown in Fig. 1 was devised to meet the need for a convenient and relatively accurate means of adding specified quantities of reagents in routine analyses. Though not recommended for precise measurements, it will deliver quantities as small as 1 ml with an error of 1 per cent. or less if care is taken to exclude bubbles from the system, and the valves are properly adjusted.

The side hole in the 6 mm tube may be blown in the usual way, but care must be taken to shrink its margins flush with the rest of the wall. It should be 1 to 2 mm in diameter. The 6 mm tube is telescoped into the 12 mm tube to allow the device to be used in bottles of various depths. If the 12 mm sheath is made 7 inches long and the 6 mm stem 8 inches, the apparatus can be adjusted to fit ordinary bottles varying from a quart to a gallon in size.

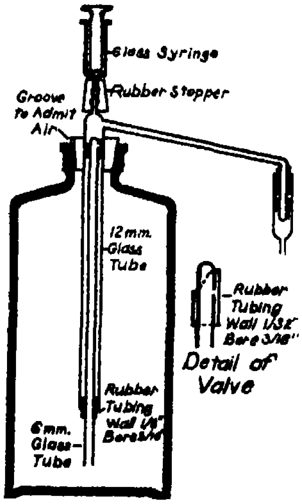

FIG. 1.

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ASTRONOMY DURING THE EARLY YEARS OF THE AMERICAN PHILOSOPHICAL SOCIETY[1]

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"IT was not without being sensible how very unequal I am to the undertaking that I first consented to comply with the request of several gentlemen for whom I have the highest esteem, and to solicit your attention to a subject which an able hand might indeed render both entertaining and instructive. I mean astronomy." These words are not my own but rather they were spoken by David Rittenhouse in an "Oration" delivered on February 24, 1775, before the American Philosophical Society. According to the minutes of the society, the oration was delivered in the college "to a crowded audience, consisting of his Honor the Governor of the Province, the Assembly, and a great number of gentlemen of the first distinction, besides the members of the Society." Moreover, the oration was dedicated "To the delegates of the Thirteen Colonies, assembled in Congress at Philadelphia, to whom the future liberties, and consequently the virtue, improvement in science and happiness in America are intrusted."

Again to quote the words of Rittenhouse:

> Astronomy, like the Christian religion, if you will allow me the comparison, has a much greater influence on our knowledge in general, and perhaps on our manners, too,

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[1] Address at the mid-winter meeting devoted to the Early History of Science and Learning in America with especial reference to the part played by the American Philosophical Society, Philadelphia, February 13 and 14, 1942.

than is commonly imagined. Though but few men are its particular votaries, yet the light it affords is universally diffused among us; and it is difficult for us to divest ourselves of its influence, . . .

You are all of you very familiar with the fact that the American Philosophical Society was founded in the year 1743. A valued letter from Benjamin Franklin kept in the society's library gives the names of the nine original members, with himself as secretary. (In 1743, Franklin, the fifteenth of seventeen children, was thirty-seven years old.)

At a meeting held in the State House on February 2, 1768, we read in the minutes:

> A Society having subsisted for some time in this City under the name of the American Society held at Philadelphia for promoting and propagating useful Knowledge, whose Views have been nearly the same with those which are published of the American Philosophical Society, and it being judged that the Ends proposed by both could be carried on with more advantage to the Public if a Union could take place between them, it is proposed that such a Union may take place.

Accordingly during the year 1768, the society took on a new lease of life and more than 100 members were elected.

Early in the following year, on Monday, January 2, 1769, the foremost citizen of Philadelphia, Benjamin Franklin, was elected president of the society, an office he continued to hold until his death in April, 1790. David Rittenhouse succeeded Franklin as president and he continued in office until his death in June, 1796.

As your speaker to-day has lived for more than twenty-five years in Virginia on Mount Jefferson in sight of Monticello, four miles distant, I hope you will pardon me for quoting from the letter of the four secretaries of the society in advising Thomas Jefferson of his election as the society's president. Under date of January 7, 1797, the letter reads:

> We have the pleasure of informing you, that at the annual Election of Officers of the American Philosophical Society for promoting useful knowledge, held at Philadelphia on the 6th inst., you were chosen President of that respectable Institution.

To this Jefferson replied:

> I have duly received your favour of the 7th inst., informing me, that the American Philosophical Society have been pleased to name me their President. The suffrage of a body which comprehends whatever the American World has of distinction in Philosophy & Science in general, is the most flattering incident of my life, and that to which I am the most sensible. . . . Permit me to avail myself of this opportunity of expressing the sincere Grief I feel for the loss of our beloved Rittenhouse. Genius, Science, modesty, purity of morals, simplicity of manners, marked him one of Nature's best samples of the Perfection she can cover under the human form. Surely, no Society till ours, within the same compass of time, ever had to deplore the loss of two such members as Franklin & Rittenhouse. Franklin, our Patriarch, whom Philosophy and Philanthropy announced the first of men, and whose name will be like a star of the first magnitude in the firmament of heaven, when the memory of those who have surrounded & obscured him, will be lost in the Abyss of time.

Jefferson continued as president of the society during the eight years he was President of the United States. Late in the year 1808, when he was planning soon to move from Washington back to his home at Monticello, Jefferson tendered his resignation as president of the society. His resignation was not accepted and he continued in office until January 6, 1815. Then after again tendering his resignation he was succeeded by Dr. Caspar Wistar.

Franklin, Rittenhouse and Jefferson between them had been presidents of the American Philosophical Society from 1769 to 1815, a space of almost half a century. The real cause of the awakening to life of the society in 1768 was literally a heaven-sent event, namely, a Transit of Venus that was most successfully observed in and near the city of Philadelphia and the genius who organized and carried the plans through to perfection was David Rittenhouse. The older members of the society have heard time and time again about Rittenhouse. To-day I wish to call briefly to the attention of the younger members and those who are not astronomers some of the high spots in the life of Rittenhouse, and at the same time to suggest to all of you that you go upstairs to the members' room and see for yourselves the astronomical clock and the transit telescope both made and used by Rittenhouse in his observations of the Transit of Venus on June 3, 1769. Also upstairs is a Dollond refractor that took part in the Transit of Venus observations and also a theodolite that formerly belonged to William Penn and which was used for laying out the City of Philadelphia.

Rittenhouse was born on April 8, 1732, in a small stone house that now stands on the main drive through Fairmount Park. Even as a boy he showed extraordinary mathematical and mechanical ability and as he grew older he was always very resourceful in supplying his own needs. He acquired great proficiency in observational, practical and theoretical astronomy and in instrument making. The construction of his first telescope dates from 1756. His first observations as an astronomer were in 1763–64 when he carried out a survey for William Penn to settle the boundary dispute with Lord Baltimore. This boundary, between the present states of Pennsylvania and Maryland, was done with such high accuracy that it became part of the Mason and Dixon line.

His early fame rested primarily on the construction of his celebrated orrery of 1767, acquired by a college founded in New Jersey in 1746 and now known as Princeton University. This first orrery was lost, but a second one is now the proud possession of the University of Pennsylvania. For each of these instruments Rittenhouse received £300.

It is most interesting to read over the minutes of the society after its reorganization in 1768. At the meeting of March 8 held at the State House, "a fine of one shilling for non-attendance of members at meetings was ordered as a by-law of the Society. Six organic committees were then constituted by distributing the members present among the committees." At this early period in the life of the first learned society in the western hemisphere, rewards for attendance and penalties for non-attendance were put into effect. The minutes of succeeding meetings of the society furnish no information, however, regarding the amount the treasury's balance was enhanced by the one shilling fines.

At the very next meeting of the society (1768, March 22), Rittenhouse described his new orrery, and at the following meeting the committee on Rittenhouse's orrery reported that "they have the greatest Reason to expect from his known Abilities" that the orrery "will do honor to himself & to this Province, the place of his Nativity; and the Committee beg Leave to recommend it to the Society to order his description to be published; not doubting but it will give Pleasure to Persons of a curious and Philosophical Turn." Hence the first paper ordered to be published by action of the society was one on astronomy, which then as now one and three-quarter centuries later had a strong popular appeal.

The description which appears as the first article in the first volume of the society's *Transactions* states that the orrery represents the motions of the sun, moon and planets, and therefore illustrates solar and lunar eclipses and other phenomena "for a period of 5000 years, either forward or backward." For showing the motions of the heavenly bodies it was the forerunner of the planetarium. Jefferson spoke of the orrery in these words: Rittenhouse "has indeed not made a world; but he has by imitation approached nearer its maker than any man who has lived from the creation to this day."

As I have indicated, it was the Transit of Venus that brought great fame to our society in its early years, and once started on the high road it has continued to function with great dignity for nearly 200 years. At the meeting on April 19, 1768, plans were started to observe the Transit from three different sites, the State House square, the Rittenhouse farm at Norriton and Cape Henlopen. In addition to Rittenhouse, other enthusiastic observers were John Ewing, provost of the University of Pennsylvania, Joseph Shippen and Hugh Williamson. The society may well be proud of Ewing. Besides being provost of the university, he was professor of natural philosophy, and it was said of him that "in the absence of any other professor, the Provost could take his place, at an hour's warning, and conduct the instruction appropriate to that Professorship with more skill, taste and advantage than the incumbent of the chair himself."

The condition at that time of the country surrounding the City of Brotherly Love may be surmised by reading from the minutes of the society that an inquiry was made "to know whether the Indians would allow proper Persons to pass through their Country in order to make the Transit of Venus observations." Perhaps the lives of the members of the expeditions sent out from this city were in no greater danger than were the lives of eclipse observers in the year 1900, for we have it on good authority that before crossing the Atlantic Ocean to witness the eclipse, the head of one of the British expeditions appealed to the United States Government to protect the lives of the party from the wild natives (sic) of North Carolina. I might add that on arriving in New York the fears were effectively dispelled when the party found themselves aboard a luxurious Pennsylvania train and discovered that they themselves, their baggage and their instruments were routed through to destination—and entirely free of charge. Of course this was in the good old days now gone forever!

For the great event, Rittenhouse had a clock which he himself had made, a transit telescope also constructed by his own hands and now considered the first telescope made in America and a refracting telescope. These instruments are now in the members' room upstairs.

For the expenses incurred in observing the Transit of Venus, the society paid more than £100 from its treasury. Thus we find that Dr. Conklin, the chairman of our research committee, has long-established precedent for paying out society's funds to aid research.

The accuracy of the observations by Rittenhouse, who was assisted by William Smith and John Lukens, has been attested by Nevil Maskelyne, astronomer royal of England at the time, and by Simon Newcomb. The latter[1] states that "his observations of the celebrated transit of Venus in 1769 have every appearance of being among the best that were made." Combination with Greenwich results by a method improved by Rittenhouse gave 8.″805 for the solar parallax, in remarkable agreement with the value 8.″803, which has been the accepted value until a few months ago when the present astronomer royal of England, H. Spencer

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[1] "Dictionary of American Biography," Vol. XV, page 63.

Jones, gave the refined value of 8.″790, coming from observations made the world over on the planet Eros.

For carrying on the observations in Philadelphia the minutes read, "The Honorable House of Representatives had generously granted the privilege of erecting the Observatory in the State House Yard, and voted £100 for erection and observation to be paid to the Society Treasurer." Thus we see that the first observatory in the United States to be created at public expense dates from the year 1768.

In 1770, Rittenhouse moved to Philadelphia. His observations included transits of Mercury, solar and lunar eclipses, variable stars, the new planet Uranus (discovered by Herschel in 1781) and comets, including one discovered by himself in 1793. His work in astronomy was many-sided. To adjust instruments in the meridian, in 1785 he invented the collimating telescope, since then universally used. The same year he introduced spider threads into his telescope. In 1786 he made a plane transmission grating, thus anticipating Fraunhofer's grating by about 30 years. Newton had previously used "scratches made in polished plates of glass," but Rittenhouse measured grating intervals and deviations of several orders of spectra. He was frequently engaged in boundary surveys and commissions involving Pennsylvania, Delaware, Maryland, Virginia, New York, New Jersey and Massachusetts. Outside of astronomy, he served on the commission to organize the United States bank, and George Washington appointed him the first director of the Mint, on April 14, 1792, thus exemplifying the fact that a resourceful practical astronomer is equipped to tackle almost any job. At the University of Pennsylvania he was professor of astronomy and later trustee and vice-provost. In the American Philosophical Society he served as curator, librarian, secretary, vice-president and president. The highest of the many honors that came to him was his election, when president of our society, as a foreign member of the Royal Society. The first American to be so honored after the Revolution was James Bowdoin, governor of Massachusetts and president of the American Academy of Arts and Sciences.

As an eclipse observer myself, I wish to direct your attention to the fact that only one week after the British evacuation of Philadelphia, "The first eclipse of the sun to be carefully observed[2] in the British colonies of America was that of June 24, 1778, which was watched by the astronomer, David Rittenhouse." Although the eclipse was total, with the gorgeous beauty of the corona readily visible to the naked eye, no mention was made in the record of Nature's most beautiful phenomenon. To us at the present day, one of the strangest portions of the history of astronomy before the middle of the nineteenth century is the evident lack of interest in, or perhaps one should say, the dearth of observations of the corona and of the rosy prominences visible without telescopic aid at the time of a total eclipse of the sun. The only scientific observations made were the accurate times of the contacts of the limbs of the sun and moon. At a total eclipse of the sun there are four contacts. Similar observations are still made at eclipses, the purpose being the perfection of the motion of the moon, which even to-day is an erratic member of the sun's family. Possibly for this reason the moon is always designated by the feminine gender.

In the midst of the revolutionary war, in 1778, life in Philadelphia evidently went on about the same whether the British soldiers were present in the city or not. That was ages before we had heard of the word "schrecklichkeit" or of "the scorched earth."

The next total solar eclipse visible in the United States was only two years later, on October 27, 1780; it was not total in Philadelphia but was total in New England. This eclipse is memorable for two distinct features. It was the occasion of the first American eclipse expedition, under Professor Williams, of Harvard College. I think you will be interested in hearing some of the details from my own book, or as published in *Memoirs American Academy of Arts and Sciences,* 1, 84, 1783. The account by Williams reads:

> Though involved in all the calamaties and distresses of a severe war, the government discovered all the attention and readiness to promote the cause of science, which could have been expected in the most peaceable and prosperous times; and passed a resolve, directing the Board of War to fit out the Lincoln galley to convey me to Penobscot, or any other port at the eastward, with such assistants as I should judge necessary.

When the great day arrived, the Harvard party found itself outside the path of totality. However, an observation of great value was made, as you may learn from the following.

> The sun's limb became so small as to appear like a circular thread or rather like a very fine horn. Both the ends lost their acuteness and seemed to break off in the form of small drops or stars some of which were round and others of an oblong figure. They would separate for a small distance, some would appear to run together again and then diminish until the whole disappeared.

Here is a clear description of the eclipse phenomenon known to all of you as Baily's beads, as the result of observation by Francis Baily, a London stock-broker at the eclipse more than a half-century later, in 1836.

Another total eclipse of the sun, that of June 16, 1806, was again visible in Massachusetts but not in Philadelphia. This might be regarded as an instance of undue partiality to the rival scientific society in Boston, the American Academy of Arts and Sciences. However, I have been pleased to find that a member of the American Philosophical Society, Andrew Ellicott by name, also described Baily's beads thirty years before the 1836 eclipse. The description I have never before seen published nor referred to. I found it in the "Manuscript Communications," Vol. 2, page 57, in a letter from Andrew Ellicott, part of which reads:

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[2] ''Eclipses of the Sun,'' page 128.

> Those detached luminous points of the sun's limb seemed to retain their brilliancy till the instant of their disappearance, which it would appear should not be the case, if the moon was surrounded with an atmosphere—those points particularly, which are formed by depression in the moon's limb would have had their splendour somewhat diminished by the density of the atmosphere, if one existed,—but nothing of the kind was observed.

In the same collection of manuscripts in the society's library, and four pages after Ellicott's letter I found another letter regarding the 1806 eclipse, this time from Simeon De Witt of Albany, N. Y., the contents of which pleased me mightily. The letter reads:

> With this I send you for the American Philosophical Society a painting intended to represent the central Eclipse of the Sun on the 16th of June last. It is executed by Mr. Ezra Ames, an eminent portrait painter of this place and gives I believe as true a representation of that grand and beautiful phenomenon as can be artificially expressed. The Edge of the moon was strongly illuminated and had the brilliancy of polished silver. No common colors could express this; I therefore directed it to be attempted as you will see by a raised silver rim which in a proper light produces tolerably well the intended effect.
>
> As no verbal description can give anything like a true Idea of this sublime spectacle with which man is so rarely gratified, I thought this painting would not be an unwelcome present to the Society or an improper article to be preserved among its collection of subjects for philosophic speculation.

A little more than a century later I myself was a Simeon De Witt and was instrumental in discovering another eminent portrait painter, Howard Russell Butler, who was with me in Oregon for the total eclipse of June 8, 1918. Again the artist and the astronomer engaged in team-work, as had been done for the eclipse of 1806, Mr. Butler in the ten days before the eclipse doing the difficult task of attempting by his skill as an artist to bring out the fire and the glory immediately surrounding the moon in the inner corona, the astronomer doing the easy task of criticizing as the result of experience gained at three previous total eclipses. Most of you have seen Mr. Butler's famous paintings of the eclipses of 1918, 1923 and 1925. For the first and third of these eclipses he was with me. He was near me at the 1923 eclipse but "unusually unusual" clouds in "beautiful sunny California" prevented him from being with me. The originals of the paintings form a triptych at the Hayden Planetarium of the American Museum of Natural History, and copies by Mr. Butler are in the Franklin Museum in this city and in the building of the National Academy of Sciences in Washington.

Andrew Ellicott (1754–1820) has been to me a most interesting character. He was of Dutch and English Quaker stock and belonged to the family that founded Ellicott City, Maryland. He was a mathematician and a surveyor and therefore an astronomer. In 1784, he was appointed member for Virginia for the group of surveyors that continued the Mason and Dixon line southward. In 1791, he began the survey, occupying two years, that gave the boundaries of the ten-mile square tract ceded by Maryland and Virginia as the site of the present District of Columbia. In 1811, Georgia invited him to run the line between that state and South Carolina. When the job was finished, Georgia refused to pay him more than his expenses for the simple reason that his line ran 18 miles farther south than Georgia's hopes. He appears to have had many stormy times in his career, but he found a haven of rest in 1813 at West Point, where he was professor of mathematics.

I have quoted from one of Ellicott's letters. Another was written from Lancaster, to Thomas Jefferson, president of the United States and of the American Philosophical Society, under date of December 29, 1801. Part of the letter reads:

> I enclose a few astronomical observations. . . . Being now the only native of the United States left, which time has not spunged (sic) away, and who has cultivated practical astronomy for the purpose of rendering it useful to *commerce, to the division of territories, and the determination* of the relative positions of the different parts of our own country, I feel a desire to keep the subject alive, till succeeded by some American, whose fortune may put it in his power to be more useful, by allowing him to devote his whole time to the improvement of so important a branch of science.

The observations referred to are chiefly lunar distances to check up on the lunar theory and to determine the longitude. From these and other letters, I have come to the conclusion that he had a fairly high opinion of his own importance and that he was at times a bit difficult to get along with, perhaps a bit cantankerous. It has been said of him that "He had a happier hand with the theodolite than he had with the pen."

In spite of some shortcomings Ellicott was a most careful observer. At the eclipse of 1806 he determined the difference in longitude between Lancaster and Greenwich. The value obtained exceeded that derived earlier by 17 seconds of arc. He gave the correct explanation for this difference, namely, "imperfections in the lunar tables, which appear to give the moon's longitude at the time of the eclipse at least 1′ too much. The error in latitude at the same time is almost insensible." Also he correctly pointed out that by noting the northern and southern limits of the moon's shadow path on the earth, "observations were made for the express purpose of correcting the lunar tables." The most perfect results following this plan were at the total eclipse of January 24, 1925, when the southern edge of the moon's shadow was accurately determined at Riverside Drive in New York City. At the top of the apartment house at 96th street and south of the street the eclipse was not total, but north of the comparatively narrow street the corona was visible and the eclipse was total. The edge of the shadow of totality was, therefore, pinned down to within two hundred and twenty-five feet on the west edge of Manhattan Island.

Going back once more to the early minutes, we find the following, noted for the meeting of 1769, September 15. "Dr. Williamson delivered to the Society a paper in which he endeavored to explain the theory of the motion of the Comets, the probability of their being inhabited, etc." This paper was referred to the Committee on Astronomy with instructions that they "publish it if they think proper without reporting." The publication appeared in *Trans.* (O.S.) 1, 1771, appendix 27–36.

My audience to-day will smile at the apparently absurd idea that comets might ever be thought to be habitable. But let us stop a minute and look back. In 1715, the great Halley[3] thought that the appearances on the eastern and western edges of the sun at a total eclipse might reasonably be expected to be different, for the reason that "the eastern limb of the moon had been exposed to the sun's rays for a fortnight, and as a consequence it would be natural to expect that the *heated lunar atmosphere* might exert some absorbing effect on the solar rays while on the contrary the western edge of the moon being in darkness and cold for two weeks could exhibit no such absorbing action." Of course we now know that the moon has no atmosphere. A half-century or more later, one of the greatest men in observational astronomy of all time thought that the dark spots on the sun might be openings into the cooler portions of the sun that even might be habitable. To Herschel, astronomy owes the great reflecting telescopes, to him we owe the discovery of the planet Uranus, and to him and to his son Sir John we owe tremendous advances, particularly in stellar astronomy. Herschel's telescopes (judged by modern standards) were very crude affairs. It was not until 1817 that the art of glass-making had advanced enough to permit Fraunhofer to construct the "great Dorpat refractor," as it was called, with the then unprecedented aperture of 9½ inches.

This review of astronomy in the early years of the society would not be complete unless I called to your attention the enormous difference in an observatory then and now. At the present time an observatory may mean a 200-inch telescope and six millions of dollars. In the eighteenth century an observatory meant a structure costing a few hundred dollars, with a telescope small and crude, the telescope usually fixed in the meridian, chiefly to determine time and to assist in surveys of the virgin country. Most of these, like that on the State House Square, had a transitory existence. The first observatory belonging to a college was not erected near Philadelphia or New York or anywhere in the North, but south of the Mason and Dixon line. I have told you of the all-round ability of John Ewing, provost of the University of Pennsylvania. To illustrate the fact that Virginia never takes second place to any state in the Union (I should add that I am not a Virginian by birth) I would like to tell you a little about a contemporary of Jefferson, by the name of James Madison (1749–1812). At the age of 28 he became the president of the College of William and Mary, the second oldest college in the United States, and later he was the first bishop of the Protestant Episcopal Church in Virginia. In the year 1780 in November, he sent to Rittenhouse observations of the eclipse of Jupiter's satellites and the value of the longitude from Paris derived therefrom. In volume 3 of the *Transactions*, page 150, reference is made to the "observatory" and to observations made of a lunar eclipse on November 2nd and of a Transit of Mercury on November 5, 1789.

The second observatory in this country was likewise not in the North but in the South, at the University of North Carolina. Joseph Caldwell was born in 1773 and graduated from Princeton when only 18 years old. At the age of 23 he went to Chapel Hill as professor of mathematics and at the age of 31 he became president of the university. In the year 1824 the trustees of the university had enough confidence in their president as to give him $6,600 and to send him to Europe to buy books and laboratory apparatus; the money spent was about equally divided between books and instruments. The equipment was chiefly astronomical and consisted in a meridian transit telescope, an altitude and altitude telescope, a refracting telescope, a good clock with a mercurial pendulum, a sextant, a Hadley's quadrant and a portable reflecting circle. An observatory was built in 1830 and 1831, largely at President Caldwell's own expense. Its cost is given as $430.29½. Unfortunately, the construction was not very solid, and the roof leaked. After President Caldwell's death, the building deteriorated and it burned in 1838. The instruments, however, were saved. My friend, Dr. MacNider (of the University of North Carolina), writes me, "I wish so much you could see these beautiful old instruments. The brass is one of the softest, loveliest things in the form of a metal that I have ever looked at." Some of Sherman's soldiers on their march to the sea passed through Chapel Hill. They too admired the lovely finish of a telescope found on a dusty shelf in one of the laboratories. In picking up the telescope tube to examine it more closely, they found something loose inside, which turned out to be two gold watches placed by professors for safe keeping in the securest place imaginable. Needless to say, the watches were immediately appropriated. When the soldiers had left the laboratory, the professors returned to wind up their watches, only to find no trace of them. The loss was at once reported to the commanding officer. The story does not end there, and furnishes another triumph for the course of true love. It is said that the commandant was in love with the daughter of the president. The gold watches were promptly recovered and were returned to their rightful owners.

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[3] *Phil. Trans.*, 29, 248, 1715.

In the North, Yale University in 1830 secured a 5-inch Dollond refractor of 10 feet focus. There was no observatory. The telescope was pulled around in the Athenaeum Tower and pointed through one of the windows. Unfortunately, the windows were low and no object more than 30 degrees above the horizon could be observed. Similarly, Harvard College[4] possessed astronomical instruments from an early date but no astronomical observatory. Harvard College Observatory was established in October, 1839.

As might have been expected, astronomy, the so-called queen of the sciences, played a most important part in the early years of the American Philosophical Society. And this was so, largely because astronomy more than any other science of 150 to 200 years ago was useful in the promotion of useful knowledge. To-day, when some of us can get along very well with a very inexpensive watch, we perhaps forget that before the days of the electric telegraph the only manner of ascertaining exact time was to make astronomical observations. Although exact time and topographic surveys were necessary as useful knowledge, the only astronomers whose names have lived throughout the two centuries are those who pursued knowledge for the useful purpose of gaining information about matters with no immediate practical application to business or to mundane affairs.

The history of astronomy of our society, revealed through manuscripts in our valuable library in the Drexel Building across the street, includes a few outstanding names of men who gained valuable knowledge regarding the distance to the sun or who progressed a step further toward solving Nature's secrets, through observations of eclipses of the sun or moon or of Jupiter's satellites.

And now in closing I wish to state that I am not vain enough to believe that you have found my review of astronomy "both entertaining and instructive," to quote the words of David Rittenhouse, even though I did find my brief excursion into the early history most entertaining and instructive to myself.

OBITUARY

ARTHUR NEWELL TALBOT

1857–1942

Arthur Newell Talbot, professor of municipal and sanitary engineering, emeritus, at the University of Illinois, died in Chicago on April 3 after a short illness. Although he had retired from formal university duties in 1926, Dr. Talbot had continued his active interest in research and in engineering society affairs, and was attending the annual meeting of the American Railway Engineering Association when stricken on March 17. Just a year previously he had relinquished the direction of the association's investigation of stresses in railroad track, a project that he had actively conducted for 27 years.

Born in Cortland, Illinois, and educated at the University of Illinois, he graduated in civil engineering in 1881. After four years of railroad engineering in the West, he returned to teach in the university in 1885. He was made professor of municipal and sanitary engineering and placed in charge of theoretical and applied mechanics in 1890. Thenceforth, his achievements are acknowledged to have "contributed more to the development and distinction of that college and its engineering experiment station than the work of any other man."

Dr. Talbot was a pioneer in engineering education and research in this country. He made numerous contributions to engineering practice in sewage disposal and sanitary engineering, in drainage and water supply, in surveying and railroad construction, in materials testing and specifications, in the construction of sewers, pavements, bridges and buildings, and in many allied fields. Beginning in 1903, he conducted extended researches in reinforced concrete and did much to establish this new building material on a rational and scientific basis of design. This work and his 27-year study of the problems of design and maintenance of railroad track are probably his greatest achievements in the field of engineering research.

Dr. Talbot was active in many engineering and scientific societies. He was a past-president and honorary member of the American Society of Civil Engineers, the American Society for Testing Materials and the Illinois Society of Engineers. He was also an honorary member of the Institution of Structural Engineers, the Western Society of Engineers, the American Water Works Association, the American Concrete Institute and the American Railway Engineering Association. He was a very active member of the Society for the Promotion of Engineering Education, and held various offices, including that of president. He was also a member of the Institution of Civil Engineers (London), the American Society of Mechanical Engineers, the American Public Health Association and the American Association for the Advancement of Science.

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[4] W. I. Milham, "Early American Observatories," *Popular Astronomy*, 45: 523, 1937.

Among other honors, Professor Talbot received the degrees of D.Sc. from the University of Pennsylvania, 1915; D.Eng. from the University of Michigan, 1916; and LL.D. from the University of Illinois, 1931. He was also the recipient of many medals and awards, including the Washington Award, Western Society of Engineers; the Henderson Medal of the Franklin Institute; the Turner Medal, American Concrete Institute; the Lamme Medal, Society for the Promotion of Engineering Education; the Fritz Medal, United Engineering Societies; and bronze plaques from the American Railway Engineering Association. In 1938, his work in developing a great materials research laboratory and staff was recognized by the University of Illinois by renaming the building in his honor, the Arthur Newell Talbot Laboratory.

A great engineer, teacher and director of research, Dr. Talbot was loved and respected for his quiet dignity, his broad technical interests and intellectual curiosity, his high ideals, his inspiring standards of thoroughness and precision, and for his kindly spirit of helpfulness and genuine interest toward all with whom he came in contact.

F. E. Richart

University of Illinois

RECENT DEATHS

Walter F. Reynolds, chief of the section of triangulation of the Division of Geodesy of the U. S. Coast and Geodetic Survey, died on May 1. He was sixty-one years old.

Edward C. Groesbeck, metallurgist of the Division of Metallurgy of the National Bureau of Standards, died on May 8 in his sixty-first year.

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH IN SWEDEN[1]

Extensive research activity is going on in Sweden, in order to find substitutes for products which can no longer be imported owing to the war. One of the most important centers for this research is the Physical-Chemical Institute, Uppsala, headed by Professor The Svedberg. The institute has now lost all the foreign research workers who used to study there, with the exception of one Swiss; nevertheless the staff has been doubled. Extensions have in particular been made to departments dealing with the many present supply problems, of which the chemical aspects fall within Professor Svedberg's own department, namely, the giant molecules. The work with different kinds of synthetic rosins and cellulose-derivatives is now progressing on a large scale. Among other objects of research may be mentioned bread. Experiments are being made to find a means of replacing imported hard wheat, which was formerly used to improve the baking qualities of bread made from Swedish native soft wheat. Investigations are also being carried out on synthetic rubber. The work has proceeded so far that the product has been evolved in the laboratories of the institute, although it is too early yet to say whether domestic production can be started and its probable extent.

One of the foremost technical means of research of this institute is the Svedberg ultra-centrifuge, which has become of the utmost importance to science. The rotor of this centrifuge is given a speed of up to 70,000 revolutions per minute by a number of oil turbines. The institute also houses such instruments for research as one of the world's largest electro-magnets and a neutron generator, both of which have been made in Sweden. In the biochemical section the experiments for locating and cultivating infantile paralysis virus and tuberculin on the basis of a new method for analyzing mixtures through molecule splitting are carried on under the direction of Professor Arne Tiselius, who has devised this method. The object in the first place is to obtain a pure form of virus. The stoppage of the import of apes for these experiments for a while threatened the workers with the loss of indispensable test animals, but it is stated that their replacement with rats has now proved acceptable.

THE WARTIME SERVICE OF HARVARD UNIVERSITY

The *Harvard Alumni Bulletin* gives the following information in regard to the wartime service of the members of the faculty.

> To describe in a few words the modification of the university to the needs of wartime becomes inevitably a recital of facts and figures—a story which has been unfolding for many months. The faculty has accepted the

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[1] From *Nature*.

duty of leading the university to war. President Conant, whose clear-voiced challenge was one of the first heard in the United States in the present fight for freedom, now serves part-time in Washington as chairman of the National Defense Research Committee. Dean Landis of the Law School heads the Office of Civilian Defense. Dean Spaulding of the Graduate School of Education holds the rank of Lieutenant Colonel as special consultant to the War Department in Army educational problems. The dean of the Medical School, Dr. Burwell, serves as chairman of a sub-committee on the procurement of medical officers and research workers. Dean Drinker, of the School of Public Health, aids important research in the problems of flying at high altitudes.

Among the teaching members of the faculty, Professor William Y. Elliott of the department of government is director of the Raw Materials Division under William L. Batt, of the War Production Board. Many other professors of the departments of government, history and economics are employed full-time by the War Production Board, the Office of the Coordinator of Information and various important branches of the Government, lending their specialized skill to the intricate problems of war.

Even more might be said of the scientific departments of the university, could the story be told. A wide variety of confidential Government war projects are carried on in the strictest secrecy in the laboratories to the north of the Memorial Hall delta; in the workrooms of the Medical School or Business School. Much of this work is under contract with the Office of Scientific Research and Development.

Others on the faculty who can not contribute to scientific work or active Government research are devoting themselves to programs of public information. Some 1,300 members of the faculty belong to American Defense-Harvard Group, pioneer war organization of the university, many of whose services have become a permanent part of the university's program. In addition to a War Service Information Bureau (headed by Professor A. J. Casner, of the Law School) five other important official groups aid students in their search for information about war work or make available to the public significant background material concerned with the progress of the war. The committees are: Selective Service (headed by John M. Russell, assistant to the president, only last week called to active duty as a Captain in the Army Air Corps), furnishing to students official information about the Selective Service law and aiding them in their formal relations with local boards; Civilian Defense (headed by Donald Scott, '00, director of the Peabody Museum), organizing the defense precautions of the university and planning the security of its resources; Wartime Speakers (headed by Acting Dean Henry W. Holmes, '03, of the School of Education), furnishing men with specialized knowledge for speeches before civic groups; Wartime Public Opinion (headed by Robert Lasch of the Omada *World Herald* and composed of Nieman Fellows) assisting the university with reports on wartime public opinion; and Pan-American Relations (headed by Professor Clarence H. Haring, '07, Master of Dunster House) caring for Latin-American students and arranging suitable programs for Latin-American visitors in the United States and American visitors in Latin America.

The entire faculty has by voluntary action placed itself on a year-round schedule without increase in pay, a step involving actual loss of income to many teachers obliged to surrender valuable summer jobs or consultative work. Their personal sacrifice is one answer to President Conant's pledge of "all resources of Harvard University" to insure a speedy and complete victory.

THE ACCELERATED PROGRAM OF MEDICAL SCHOOLS

As a war measure, programs have been initiated to increase the supply of physicians for the Army, Navy and civilian population by the adoption of an accelerated program of medical education by the various medical schools of the country. The *Journal* of the American Medical Association reports that in connection with the adoption of such programs, the Council on Medical Education and Hospitals of the American Medical Association, the Association of American Medical Colleges and the Federation of State Medical Boards of the United States in February, 1942, adopted resolutions as follows:

Council on Medical Education and Hospitals of the American Medical Association.—The council is of the opinion that the adoption of a program for an accelerated curriculum for approved medical schools during this war period is a decision which should be determined by each medical school.

The decision of a medical school to initiate an accelerated curriculum should be made only after a comprehensive survey of the personnel, facilities and equipment of the school and its ability to give a medical education without deterioration of the quality of the medical instruction and in conformity with the statutes of the various states and the rulings of the state medical boards.

The council stands ready to make necessary inspections whenever in its judgment such inspections are required to maintain the present high standards of medical education.

The council believes that financial assistance for needy medical students during the accelerated program is best provided through scholarships or loans.

Association of American Medical Colleges.—The executive council requested approval of the recommendations sent to the deans of member colleges December 18 and December 23, 1941, urging member colleges, which can do so without any lowering of present standards of medical education, to go on an accelerated program of instruction on or about July 1, 1942.

Attention is called to the fact that the executive council recommended that only those medical colleges that can do so without lowering present standards of medical education should adopt the accelerated program. This applies not only to the utilization of the summer as a teaching period but also to the interval at which freshman classes are admitted; that is, whether annually or at approximately nine-month intervals.

The executive council recommends that the accelerated program consist of four full academic sessions of not less than thirty-two weeks each and that graduation shall not follow sooner than thirty-five months after first matriculation as a freshman.

The executive council recommends that as many colleges as can do so start instruction of the next freshman class on or about July 1, 1942, and subsequent freshman classes at approximately nine-month intervals until July 1, 1945.

The executive council recommends that, in admitting students for the accelerated program, eligibility requirements for admission be not lowered from the present minimum standards set by the Association of American Medical Colleges.

The Association of American Medical Colleges requests that the Federation of State Medical Boards recommend to its members that they arrange to make whatever changes are necessary in state licensing laws and/or board regulations to legalize licensure of students graduating under the accelerated program adopted by medical schools to meet the needs of the national emergency.

Federation of State Medical Boards of the United States.—WHEREAS, As a war emergency measure several approved medical schools of the United States are contemplating accelerating the courses of medical education so as to comprise four full academic sessions of at least thirty-two weeks each and that at least thirty-six months shall elapse between the beginning of medical instruction and graduation; and

WHEREAS, The medical schools initiating such an accelerated curriculum will be able to maintain the personnel, facilities and equipment necessary to give a medical education without deterioration of the quality of the medical instruction and in conformity with the statutes and licensure regulations of their respective states and territories of the United States and the District of Columbia; and

WHEREAS, The proposed accelerated course of medical education as a war emergency measure is expected not to extend beyond the present period of war emergency; therefore be it

Resolved, That the Federation of State Medical Boards of the United States in annual session assembled in Chicago, February 17, 1942, hereby endorse the proposed accelerated course of medical education and recommend it in principle as a war emergency measure for favorable consideration by the licensing authorities of the several states and territories of the United States and the District of Columbia.

In adopting these resolutions, all three agencies emphasized the importance of the maintenance of high standards of medical education in connection with any program adopted.

THE SEVENTY-FIFTH ANNIVERSARY CELEBRATION OF THE TORREY BOTANICAL CLUB

THE seventy-fifth anniversary celebration of the Torrey Botanical Club will be held from June 22 to 27 at Columbia University, the New York Botanical Garden, the Brooklyn Botanical Garden and the Boyce Thompson Institute for Plant Research, Yonkers. The history of the institutions at which the meeting is held will be given at the opening session of each as follows:

The History of Botany at Columbia University, by Dr. John S. Karling, professor of botany.

The History of the New York Botanical Garden, by Dr. William J. Robbins, director.

The History and Organization of the Boyce Thompson Institute, by Dr. William J. Crocker, director.

The History of the Brooklyn Botanic Garden, by Dr. C. Stuart Gager, director.

During the week symposia are planned as follows:

June 22 *Symposium on Morphology:* Speakers: Dr. F. T. Lewis, Dr. C. E. Allen, Dr. R. H. Wetmore and Dr. E. W. Sinnott.

June 23 *Symposium on Taxonomy:* Speakers: Dr. H. A. Gleason, Dr. H. K. Swenson, Dr. E. D. Merrill and Dr. F. D. Korn.

June 24 *Symposium on Growth:* Speakers: Dr. L. O. Kunkel, Princeton, N. J., Dr. P. W. Zimmerman and Dr. Oscar Riddle.

June 25 *Symposium on Genetics:* Speakers: Dr. George H. Shull, Dr. Stanley Cain, Dr. George M. Reed and Dr. A. F. Blakeslee.

Dr. Robbins will give a public lecture at the American Museum of Natural History on the afternoon of June 24. It will be entitled "Plants Need Vitamins Too."

The anniversary banquet will be held on the evening of June 22. There will be luncheons, inspection tours of the gardens and laboratories and a two-day field trip under the direction of Dr. John H. Small, of the New Jersey College for Women.

SCIENTIFIC NOTES AND NEWS

ACCORDING to a United Press dispatch, the Russian Academy of Sciences has elected to honorary membership three Americans and two Englishmen, the first foreigners to be so honored since the Russian revolution. The Americans are Dr. Walter Bradford Cannon, George Higginson professor of physiology at Harvard University; Dr. Gilbert Newton Lewis, professor of chemistry, and Dr. Ernest Orlando Lawrence, professor of physics, both of the University of California. The Englishmen are Sir Henry Hallett Dale, president of the Royal Society and director of the National Institute for Medical Research, and Dr. John B. S. Haldane, professor of biometry, University College, London.

AT its fifty-seventh annual meeting in Atlantic City, the George M. Kober Medal of the Association of American Physicians was presented to Dr. Donald D. Van Slyke, member of the Rockefeller Institute for Medical Research, New York. Dr. Van Slyke was cited in recognition of "his contributions to the treatment of diabetes and Bright's disease, as well as for his work on the oxygen treatment of pneumonia."

THE Willard Gibbs Medal meeting of the Chicago Section of the American Chemical Society will take place at the Stevens Hotel on May 22. Thomas Midgley, Jr., vice-president of the Ethyl Gas Corporation, recipient of the award, will deliver an address on "A Critical Examination of Some Concepts in Rubber Chemistry."

THE award for "distinguished service in the interpretation of higher education" of the American College Publicity Association was presented on May 9 at the closing session of the twenty-fifth annual convention to Watson Davis, director of Science Service. He was cited for his "years of faithful interpretation of research in science and its translation into terms understandable to the reading public with no loss of dignity or essential meaning."

THE Howard Taylor Ricketts Prize of $200 of the Division of the Biological Sciences of the University of Chicago has been awarded to Dr. José Oliver-Gonzalez, a Puerto Rican by birth, research associate at the university, in recognition of his work indicating that trichinosis is caused by two forms of parasite and therefore immunity to the disease can be produced only by the formation of two antibodies. The prize was established in 1913, in honor of Dr. Howard Taylor Ricketts, of the University of Chicago, who discovered the cause of Rocky Mountain spotted fever. He died in 1910.

AT the annual Buckstone Browne luncheon of the Royal College of Surgeons, London, honorary fellowship was conferred on Professor Antoni Jurasz, dean of the Polish Faculty of Medicine of the University of Edinburgh.

PURDUE UNIVERSITY conferred on May 3 the honorary doctorate of science on Francis Eugene Bibbins, chief pharmacist of Eli Lilly and Company, Indianapolis.

DR. HERBERT F. PRYTHERCH, director of the U. S. Fishery Biological Laboratory at Beaufort, N. C., was elected to the presidency of the North Carolina Academy of Science at its recent annual meeting in Greensboro.

AT the twenty-seventh annual meeting of the South Dakota Academy of Science held at the University of South Dakota, Vermillion, on May 1 and 2, the following officers were elected for the coming year: Dr. Edwin H. Shaw, Jr., University, *President;* Dr. Orin Lofthus, Augustana, *First Vice-president;* Dr. Lester Guss, State College, *Second Vice-president;* and Dr. A. L. Haines, University, *Secretary-Treasurer.* Dr. Walter F. Loehwing, head of the department of botany of the State University of Iowa, was the guest speaker. His address was entitled "Recent Advances in Botanical Research." The academy will meet next year at Huron College.

DR. CHARLES N. FREY, director of research of the Fleischmann Laboratory of Standard Brands, Inc., was elected chairman of the New York Section of the American Chemical Society at the annual meeting on May 8. Professor Vincent du Vigneaud, head of the department of biochemistry at the Cornell University Medical College, was chosen chairman-elect to take office in 1943.

DR. GEORGE BLUMER, since 1920 David P. Smith clinical professor at Yale University Medical School, was elected president of the Association of American Physicians at the Atlantic City meeting. He succeeds Dr. James H. Means, Jackson professor of clinical medicine at the Harvard Medical School. Dr. Warfield T. Longcope, of the Johns Hopkins University, was elected vice-president; Dr. Joseph T. Hearn, Cleveland, secretary, and Colonel Hugh J. Morgan, of the U. S. Army Medical Corps, councillor.

KARL P. SCHMIDT, chief curator of the department of zoology of Field Museum, Chicago, was elected at the New York meeting president of the American Society of Ichthyologists and Herpetologists. Mr. Schmidt has been appointed a special lecturer for a period of three years in the department of zoology at the University of Chicago.

THE Virginia Chapter of the Sigma Xi held its annual meeting at the University of Virginia on May 5. Twenty-six members were initiated. Lieutenant-Commander Thomas F. Ball, U. S. Naval Academy, was elected from the alumni and Professor Charles Henderson from the faculty of the University of Virginia. The annual speaker was Dr. Forest Ray Moulton, permanent secretary of the American Association for the Advancement of Science.

PROFESSOR RALPH S. HOSMER, since 1914 head of the department of forestry of Cornell University, will retire on June 30.

DR. H. W. KOSTMAYER has been named to serve as acting dean of the School of Medicine of Tulane University of Louisiana during the absence of Dean Maxwell E. Lapham, now on assignment in the Navy.

DR. J. MONTEATH ROBERTSON, senior lecturer in physical chemistry at the University of Sheffield, has been appointed Gardiner professor of chemistry at the University of Glasgow. He will succeed in October Professor T. S. Patterson, who has been for forty years a member of the department. Dr. Robertson was from 1928 to 1930 a Commonwealth fellow at the University of Michigan and at the Gates Chemical Laboratory of the California Institute of Technology.

THE War Department has activated the 118th general hospital unit, which is one section of the Johns Hopkins University Hospital Unit. It will be under the command of Colonel George Finney, the son of Colonel J. M. T. Finney, who was at the head of a similar unit in France during the last war.

DR. DINSMORE ALTER, director of the Griffith Observatory, Los Angeles, has been called to active service as Colonel of Coast Artillery in the Army of the United States. During his absence, Dr. C. H. Cleminshaw, the assistant director, will be acting director.

DR. JULIAN HUXLEY, whose post as secretary of the Zoological Society, London, was suspended by the council for the duration of the war while he was lecturing in the United States, has returned to England. At the annual meeting of the council on April 29 a body of fellows nominated Lord Horder for the presidency and Dr. Huxley for the secretaryship, which they say was "illegally" suspended.

THE *News Bulletin* of the Institute of International Education states that Dr. Hernane Tavares de Sá, professor of biology at the University of São Paulo, is making an eight-month tour of the United States during which he expects to visit seventy-five North American colleges and universities. The Institute of International Education and Westminster College, Fulton, Mo., have cooperated in awarding to him a travel fellowship for a study of the educational systems of the United States.

DR. EUGENE M. K. GEILING, professor of pharmacology at the University of Chicago Medical School, will deliver the eighth and last Harvey Society Lecture of the current series at the New York Academy of Medicine on May 21. He will speak on "The Comparative Anatomy and Pharmacology of the Pituitary Body."

THE James Arthur Lecture was given on May 14 at the American Museum of Natural History by Dr. George Pinkley, of the department of comparative anatomy of the museum. The lecture was entitled "A History of the Human Brain."

LORD RAYLEIGH delivered on April 16 the first Sir Joseph J. Thomson Memorial Lecture of the British Chemical Society.

THE annual meeting of the American Home Economics Association will be held in Boston from June 21 to 24. Dr. George R. Minot, director of the Thorndike Memorial Laboratory of the Harvard Medical School, will be among the speakers.

THE twentieth annual meeting of the American Institute of Chemists will be held on May 16 at the Hotel Claridge, Atlantic City, N. J. New officers will be elected at the business meeting in the morning. The afternoon meeting will be devoted to a symposium on "The Chemical Industry at War," with the following speakers: Dr. Gustav Egloff, Universal Oil Products Company, "The Petroleum Chemist at War"; Dr. Donald Price, technical director, National Oil Products Company, "The Chemist in To-day's Industry"; Dr. A. B. Ray, Carbide and Carbon Chemicals Corporation, "The Technical Point of View"; and Colonel O. C. Wyman, liaison officer, third Regional Labor Supply Committee, "The Chemical Industry, Selective Service and the War Effort." The medal of the institute will be presented to Dr. William Lloyd Evans, professor emeritus of the Ohio State University, at a banquet to be held in the evening. Dr. H. B. Hass, head of the department of chemistry of Purdue University, will discuss the "Career of the Medalist." Dr. Evans's acceptance address is entitled "Some Chemical Reactions of the Reducing Sugars in Alkaline Solutions."

THE ninety-third annual session of the American Medical Association will be held in Atlantic City from June 8 to 12. The House of Delegates will convene at 10 A.M. on Monday. The sixteen scientific sections of the association, the Medical Corps of the Army, the Medical Corps of the Navy and the Public Health Service are entitled to one delegate each. The Scientific Assembly will open with a general meeting, to be held at 8 P.M. on Tuesday, June 9. The sections will meet on Wednesday, Thursday and Friday, June 10, 11 and 12. Dr. Frank H. Lahey, Boston, is president of the association. The president-elect is Dr. Fred W. Rankin, of Lexington, Ky.

THE annual spring meeting of the Pennsylvania Conference of College Physics Teachers was held on April 17 and 18 at Immaculata College, Pennsylvania. One hundred and forty-two delegates representing thirty-five colleges were in attendance. The Reverend J. Joseph Lynch, S.J., chairman of the department of physics of Fordham University, addressed the conference on "The Interior of the Earth" on Friday evening. The Saturday morning program was given over to a symposium on "Physics During the War and Post-war Peace" conducted by Dr. Wheeler P. Davey, professor of research physics at the Pennsylvania State College.

ON the occasion of the meeting of the American Mathematical Society in Chicago on April 17 and 18 there was read a telegram from a group of Russian mathematicians addressed to all American mathematicians, expressing feelings of scientific unity and a belief in the triumph of our common cause.

Nature reports that the Parliamentary Secretary of the British Ministry of Information (Ernest Thurtle, M.P.) opened a conference of British scientific and technical institutes on March 9 at which Sir John Russell, adviser to the Soviet Relations Branch of the Ministry of Information, took the chair. The conference, which took place in the rooms of the Royal Society, was called to discuss an intensification of the exchange of technical and scientific information between the U.S.S.R. and Great Britain. Some sixty scientific organizations and learned societies of Great Britain sent representatives to the conference, and it was decided to set up a standing committee to assist the Ministry of Information in this work and to act as a clearing-house between organizations in Great Britain and the U.S.S.R. A representative of the Soviet Government will be invited to join the subcommittee.

M. N. SHAFFNER, secretary and treasurer of the Field Conferences of Pennsylvania Geologists, states that the opinion of many of the members appears to be that in view of the accelerated schedule in many schools and the rubber shortage, it is doubtful if a meeting in 1942 would be well attended. Therefore, it has been decided to postpone the meeting until 1943, and probably for the duration of the war.

DISCUSSION

AN UNTRIED METHOD OF FEDERAL REAPPORTIONMENT

SINCE 1928, when SCIENCE opened its columns to a discussion of the best method of Federal reapportionment several problems then before the country have been solved and several new issues raised.[1] Two bills on the subject have become laws[2] and for some years at least no more legislation is likely. The time is ripe, therefore, for a survey of the gains and the outlook.

The gains include:

(a) A guarantee against a repetition of that failure to reapportion after a decennial census which aroused Congress and the country between 1920 and 1930.

(b) A check since 1910, probably a permanent check, upon the steady enlargement of the House under which it grew between 1790 and 1910 from 106 to 435 seats, a decennial average of 27 seats.

(c) A reduction in the number of methods mentioned in the law of 1929 from two to one, thus decreasing the likelihood that Congress will have to struggle again with the troublesome problem of method.

(d) A probability that each future apportionment will be made automatically, thus withdrawing a time-consuming subject from the floor of Congress.

The issues still open concern three questions:

(1) What is the best method of apportionment?

(2) Can a process of slight automatic decrease in the size of the House after each census be started?

(3) Can the rapid growth of rotten borough Congressional districts in a few States which State legislatures have failed to stop be ended by Federal legislation?

I must not ask for space in your columns to explain *these gains or even to examine at length the second or third of the open issues.* About the second let me say only that if the words in the law of 1929 "under an apportionment of the then existing number of Representatives" should be changed to "under an apportionment of five (perhaps even ten) less than the existing number of Representatives" such a change would not endanger the automatic feature of the law and would start a process of reducing the size of the House towards the three hundred members often mentioned in Congressional debates as a desirable but unattainable goal.

A longer amendment requiring approximate equality in the population of Congressional districts would stamp out the growing evil of rotten borough Congressional districts. That the evil is serious appears from the following figures of the average percentage of excess in the population of the largest Congressional district over that of the smallest in the same State.

Date of census	Average percentage of excess
1900	41
1910	54
1920	86
1930	107

Both of these amendments I may be able to explain and defend in quieter times before the appropriate Congressional committees.

But as neither of these changes is of especial interest to scientists I pass them by to raise again two fundamental questions about method. (1) What should the scholar regard as the best method of apportionment? (2) How would that method be regarded by Congress?

The two outstanding men in American history who have examined the question of method are Thomas Jefferson, who had charge of the first census, and Daniel Webster. The method of major fractions which was introduced in 1910 and has now been superseded by the method of equal proportions is a modernization of Webster's plan. The method I now prefer, the method of smallest divisors, is a modernization of Jefferson's. Like all modern methods but unlike Jefferson's it starts by assigning one Representative to each State because it interprets the phrase "each State shall have at least one Representative" as requiring that procedure. The seats of these 48 who might be called constitutional Representatives are as much outside the control of Congress as are those of the Senators. It is only after this initial step has been taken that the process of Congressional or statutory apportionment can begin. All modern apportionment tables like those prepared by the Bureau of the Census begin with Representative number 49 not with Representative number 1. If we accept this as a starting point it follows that in every Congress there are two groups of Representatives, a constitutional group—one for each State—among whom population counts for nothing, and a statutory group among whom population counts for everything.

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[1] For earlier contributions to this discussion see SCIENCE, 67: 509, 1928; 68: 579, 1928; 69: 163, 272 and 356, 1929; *Sociometry*, 4: 278, 1941.

[2] Acts of June 18, 1929, Sec. 22, and amending Act of November 15, 1941.

In this group of 48 constitutional Representatives with which apportionment starts the one from New York stands for 122 times as many constituents as the one from Nevada. The object of Congressional or statutory apportionment which then begins should be to reduce this inequality as rapidly and completely as possible. It can best be done by giving each Representative after number 48 to the State which at that point has the largest population per Representative. All methods give seat number 49 to New York and seat number 50 to Pennsylvania, but thereafter the results diverge. The only test by which Congress judges a method is its results. The difference in result of the five methods examined in 1929 by a committee of mathematicians appointed by the National Academy of Sciences appears when we consider how Representatives, numbers 51 and 52, are apportioned by each. After seat number 49 has been assigned to New York and seat number 50 to Pennsylvania the situation is as shown in Table 1.

TABLE 1

State	Number of Representatives	Population per Representative (in thousands)
Nevada	1	110
....		
New York	2	6,740
California	1	6,907
Ohio	1	6,908
Illinois	1	7,807

The method of greatest divisors and the method of major fractions give seat number 51 to New York, raising its total to 3; each of the other methods gives it to Illinois. Every member of Congress and the overwhelming majority of citizens would probably say that of these four States Illinois has the strongest claim to seat 51 and that any method giving it to New York should be discarded.

After Illinois has received a second seat the other three States would stand as in Table 2.

TABLE 2

State	Number of Representatives	Population per Representative (in thousands)
Nevada	1	110
....		
New York	2	6,740
California	1	6,907
Ohio	1	6,908

The method of equal proportions and that of the harmonic mean give a third seat to New York before Ohio or California receives a second. Here again the average member of Congress doubtless would regard the claim of both States to a second seat as coming ahead of that of New York to a third. If so, the method of equal proportions and the method of the harmonic mean should also be discarded and that of smallest divisors adopted.

The test of fairness which appeals most strongly to the average Representative probably is the approach to equality in the population or average population per district in the 48 States. Next to this is a wish to keep the average of the State averages as low as possible. Tried by either test the method of smallest divisors comes out better than that of equal proportions. Under the 1940 conditions the average of the State averages by the method of equal proportions is 294,000, by that of smallest divisors 283,000, and the range between the average population per district in the State where it is largest and that where it is smallest under the method of equal proportions is 249,000, but under that of smallest divisors 207,000.

A disadvantage of the method of smallest divisors is that it transfers to the group of small States several seats which by any other method would go to the group of large States. This results from the advantage it gives to the small States in the group of 48 constitutional Representatives, an advantage not counterbalanced later as from that point on no advantage is given to either group. Whether this disadvantage would outweigh the advantages already mentioned must be left for Congress to decide. Here we are concerned only with theoretical considerations and those I believe count heavily in favor of this novel method.

A closing word about nomenclature. I have accepted the names preferred by mathematicians, although to the average Representative they carry no meaning. For that reason mainly I prefer the following:

The Thomas Jefferson approach 1790–1830 = method of greatest divisors
The Daniel Webster approach 1840 = method of major fractions
The Samuel Vinton approach 1850–1900 = Vinton method
The sliding divisor approach 1910–1930 = modernized Webster method
The mathematical approach 1940 = method of equal proportions
The double method approach ? = modernized Jefferson method

WALTER F. WILLCOX

ITHACA, N. Y.

TICK PARASITES ON CAPE COD

DURING the summer of 1926 the chalcid fly *Hunterellus hookeri* How., with which *Ixodiphagus caucurtei* du Buyson has been shown to be identical,[1] was released on the island of Naushon in southern Massachusetts by Larousse, King and Wolbach,[2] in an attempt to control the American dog tick, *Dermacentor variabilis* Say. Specimens of this fly were taken on the island the following summer. Furthermore, a parasitized tick was found there in 1929 by Hertig[3] in a lot of some 400 nymphs of *D. variabilis.* The parasites were not identified.

In July and early August of 1940, 1,470 engorged immature ticks were collected on Naushon Island. Of these 90 per cent. were *D. variabilis,* 513 larvae and 841 nymphs, and the remainder were of the genus *Ixodes,* 113 larvae and 23 nymphs. The *Ixodes* that reached the adult stage proved to be *I. ricinus scapularis,* and it is believed that the others were the same. One larva of *D. variabilis* yielded two specimens of *Ixodiphagus texanus* How. This is believed to be the first report of this species as a parasite of the American dog tick. But it is not the first record in this part of the country, for the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, has a number of records from Oak Bluffs, Massachusetts, in *Haemaphysalis leoporis-palustris* and *Ixodes dentatus.*

Hunterellus hookeri was not found parasitizing any of the above-mentioned ticks. However five adults were collected in the hair of a Setter dog, two about July 28 and three about August 20. Since the average life of an adult is about forty-eight hours, there probably is a fairly large population of the fly on the island, which is principally parasitizing some species other than *D. variabilis.* The only previous report of adults seen in nature is by Cooley.[4] It is felt that the introduction of *H. hookeri* is not a useful measure for the control of the American dog tick.

I am indebted to Dr. A. B. Gahan and Dr. C. N. Smith, of the Bureau of Entomology and Plant Quarantine, for assistance with the identifications; and to Dr. H. S. Forbes for hospitality and assistance.

SIDNEY COBB

HARVARD MEDICAL SCHOOL

THE EFFECTIVE PRESENTATION OF SCIENTIFIC REPORTS

CONGRATULATIONS to Professor E. F. DuBois, of Cornell University Medical School, for the intriguing and worthwhile discussion which he has precipitated by his note of March 13 in SCIENCE on the effective oral presentation of scientific material.

The additional comments of John B. Lucke, Gilbert Dalldorf and Jean Broadhurst in SCIENCE for April 10, reveal further thinking on this truly commendable topic of discussion.

Perhaps no group of men in the country are more aware of the deficiencies of scientific papers, as read at many science meetings, than are the members of the National Association of Science Writers; those professional journalists who devote their full time to the reporting of the news of science and who attend, constantly, the major science meetings of the nation.

As a member of the National Association of Science Writers, and with the past benefit of many discussions with its members on this very subject, the following suggestions are offered for the research scientists.

The greatest fault of scientists would appear to be that they try to present material orally which is intended primarily for publication in a technical magazine.

No matter how skilled an orator a man may be, the unwise choice of words for spoken delivery can not overcome this basic handicap. The technical terminology of almost any phase of science is certainly near the peak of boredom for the human ear.

Lack of skill in oral presentation is a handicap, but one can not chide the research scientist too much on this score, for he has other things to do beside taking elocution lessons.

Nor can one expect a scientist to rehearse his address with the intensity of the director of a radio program who has nothing else in the world to do.

What scientists can do, however, is to rise above the laziness whereby they try to kill two birds with one stone. More effort needs to be made to tell their research story simply and with a minimum of technical terms which seem to be the trademark of any technical report at a scientific meeting.

If reports to scientific meetings are intended for later publication, as many of them are, let there be two drafts made of them; one to be mailed to the editor of a technical journal and the other summarizing the findings for quick and compact oral presentation.

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[1] A. B. Gahan, *Proc. Ent. Soc. of Wash.,* 36: 89, 1934.

[2] SCIENCE, 67: 851, 1928.

[3] A. Hertig, personal communication.

[4] *Onderstepoort Jour. Vet. Sci.,* 3: 23, 1934.

Actually, many of the reports to any large scientific meeting—say the Christmas meetings of the American Association for the Advancement of Science—never see permanent record in print.

Space available in technical journals to-day is much too precious to record, for all posterity, every obscure and minor advance of science. These minor papers, which make up the bulk of almost any meeting, can serve their function best if they are presented most attractively to the listening audience, for that is about as far as they will go; that and perhaps the title, and a short abstract in the program of the meeting.

In preparing an effective oral presentation of their subject-matter it might be wise for scientists to adopt something of the technique of the professional science writers who place the question, "What does it mean?" at the top of their list of requirements.

Every one, layman and scientist alike, is interested in what any new discovery in science means to the broad path of progress. That is why the newspaper reporting of science for the layman emphasizes the significance of a discovery in the very first paragraph. If the significance were buried at the end of the paper, in the fashion of a scientific report, no one would ever bother to read it.

Scientists may not like to hear it put so bluntly but, seriously, no one in the world cares what they are doing, or how they did it or even who did it. All people are interested in about any scientific discovery is, "What does it mean?"

The technical details, occupying so great a part of technical scientific reports, interest only other specialists in that particular field. The rare exceptions are those reports important enough to have wide applications in other fields of science.

This situation is true even within a given branch of science and in physics—as an example—the boredom among the electrical experts when the band spectroscopists are talking is equalled only by the boredom among the latter, when the former speak. The same thing might well be said of the various specialists in the medical sciences when they listen to each other's papers.

All this means that a scientist, in reporting his work to a scientific society, might come to the meeting armed with two manuscripts. One would be his technical paper that he hopes may some day appear in print; the kind of report which he now reads to a bored audience. This report he would keep out of sight in his innermost pocket. Its sole use would be for those very few interested individuals who come up to him after the talk for more technical details.

The other manuscript would be his oral presentation. It would tell the story of his work in a simple, summary fashion with the emphasis on what has been accomplished, rather than on how it was done. It would be intended to tell the story for *intelligent* but *ignorant* laymen, for scientists—outside their own specialized niche in science—are just that. As such they are interested in what a new discovery means rather than the specific details of how it was done.

Mr. Lucke, in his comments in SCIENCE for April 10, rightly takes scientists to task for "reading" their reports in a fumbling, halting fashion.

However, most scientists, if they will prepare their material simply for oral presentation and use a minimum of scientific terms, will find that they will be able to "read" their papers with effectiveness and with interest to their audience.

Scientists are obviously too busy—or should be too busy—with their research to have time to take a course in public speaking (although if their reputation rises to such a degree that they are in demand for many addresses they ought to consider this possibility).

However, mere reading of a statement written in oral English, in contrast to written and scientific English, can be very effective.

The best spokesman in the world to-day is President Roosevelt. He *reads* his fireside chats. Not every one can be a Roosevelt in radio or speaking style, but every one can say things simply. Every one can avoid the laziness, for that is what it is, of trying to kill two birds with one stone by trying to read a complex scientific article whose ultimate end is to appear in print in a scientific publication. Even the President couldn't do that and make any one enjoy it.

ROBERT D. POTTER,
Science Editor, The American Weekly

SCIENTIFIC BOOKS

ROTATIONS IN PSYCHOLOGY AND THE STATISTICAL REVOLUTION

Factor Analysis. A Synthesis of Factorial Methods. By KARL J. HOLZINGER and HARRY H. HARMAN. Chicago: The University of Chicago Press. 1941. $5.00.

AMONG 24 variates the number of correlation coefficients is $24 \times 23/2 = 276$, and one might perhaps imagine that about half of these would be positive and half negative. Actually, when Holzinger and Swineford worked out the correlations among 24 mental tests given to a large group of school children they found 275 positive correlations, mostly of substantial magnitude, and only one negative correlation, which had the insignificant value -.075. Eight bodily measurements made by Dr. F. Mullen on 305 fifteen-year-old girls yielded 28 correlations, all of which were positive and of significant size. These facts, which could be paralleled in many other cases, point to the existence of underlying factors or causes common to the several tests or measurements. The girls who were big around the chest were also, on the average, bigger around the waist and had longer arms and legs than those smaller than the average in chest girth. In other words, some girls were big in general and some were small in general, though what was directly measured was in each case not general size but one of its many manifestations. The students who were good at word meanings were also good at addition and at counting groups of dots; in fact they were, on the average, better on everything on which they were tested than were their classmates who were less good at word meanings or in other individual tests. This and many similar observations constitute clear proof of the existence of something in the nature of general mental ability, varying from person to person, and affecting the degree of success attained by the person in anything he tries within a very extended category of mental activities.

When it is once recognized that an aggregate of such measurements is to a considerable extent a set of different measures of the same thing, the problem arises of choosing suitable weights for combining the several measures in order to arrive at the fundamental variate underlying all of them as nearly as possible. At this point there is a good deal of indeterminateness for lack of a universally acceptable criterion as to what constitutes the best possible set of weights. A semblance of agreement is reached because of the fact that any set of *positive* weights applied to the positively correlated measures gives a weighted mean that might plausibly be taken to represent general intelligence or whatever the underlying common factor may be. But when deviations from such a weighted mean are correlated there is also evidence in the residual correlations of further common factors, quite independent of the first one considered. In tests of school children, for example, there seems to be a common quality, independent of general intelligence and secondary to it in effect on total variance, that represents a contrast between verbal ability on the one hand and arithmetical ability or speed on the other. Indeed, there is evidence of several sorts of ability or differences of contrasting abilities, which so to speak must be measured in different dimensions, since they are statistically independent of one another, though they all contribute in varying measure to success in the tests. But to identify such fundamental "factors," to specify them as definite functions of the test scores, and, above all, to give them names, requires something on which different workers have not been able to agree.

A large number of schemes for the statistical treatment of such problems has been proposed. The volume now at hand is a compendium of most of them, with a good account of their bases and mutual relations, including the rotations of axes involved in getting from one to another. The introductory chapter includes an excellent discussion of certain relevant phases of scientific method in general. Matrix algebra and n-dimensional geometry are essential in this subject, and the reader is provided with introductions to these and some other mathematical topics in special sections. An extraordinarily clear elementary treatment is given of rotations in n dimensions. Correlated as well as uncorrelated sets of "factors" are discussed, there is a chapter on the estimation of the values of the factors for individuals in terms of their test scores, and some essential indeterminacies in the problem are duly indicated. There is an appropriate emphasis on the criterion of "parsimony," that is, on the desirability of using the smallest possible number of variates to describe a phenomenon. However, this criterion is apparently overlooked in the preference shown for types of solution involving not only general factors common to several tests or all of them, but also individual factors specific to each test and not entering into any other. Thus the whole number of factors used is actually greater than the number of tests, though the original object was to represent a large number of tests by a small number of factors.

This subject of "factor analysis" has received much attention from psychologists in recent years, and is altogether fascinating. Its potential applications go far beyond the domain of psychology. It is in fact a branch of the theory of multivariate statistical analysis, which is in turn a branch of the theory of statistics, and has applications in the most diverse fields in both natural and social sciences. Unfortunately, this logical position has frequently been overlooked by workers in factor analysis, who have treated it as a branch of psychology, and have therefore not thought it necessary or worth while to keep in touch with the rapid advances that have been taking place in multivariate analysis and in general statistical theory. The result is that factor analysis, after a brilliant start years ago, has come to be surrounded by an aura of obsolescent statistical methods, concepts and terminology. Its isolation from the main body of statistical theory has left factor analysis in a state which can not exactly be described as stagnation, since there is so much activity, but also can not be regarded as wholly healthy.

The work of R. A. Fisher on the theory of estimation, and that of J. Neyman and E. S. Pearson on testing hypotheses, have rendered obsolete the criteria for selection of a statistic used in most textbooks on statistics and by most factor analysts. The sampling distribution appears instead as the fundamental basis from which must be derived the choice of a statistic and the method of testing a hypothesis, governing the whole investigation from start to finish. Factor analysis persists in the old habit of regarding sampling distributions as luxuries to be considered after everything else is done, if at all. Modern statistical theory aims at getting exact sampling distributions, sometimes succeeds and, in case of failure, examines a variety of approximations with a clear consciousness of the distribution that is to be approximated. In this whole comprehensive treatise on factor analysis there is not one exact sampling distribution, nor any more modern basis for the sampling theory than the Pearson-Filon paper of 1898. Criteria such as those of maximum likelihood, minimum variance and uniformly most powerful tests lead modern statistical theory to recommend as the bases of calculation functions found by applying the methods of the calculus to the determination of maxima and minima of well-defined functions of the observations. Something of this concern with maxima and minima appears in factor analysis, but is much obscured by the injection of hypothetical "communalities" and the like into the data in such a way as to vitiate accurate statistical discrimination between rival hypotheses.

One bit of fallacious reasoning seems in the past to have affected a good deal of thinking about factor analysis and multivariate statistical theory in general, and to have given the subject a directive impulse that still persists. If p measurements are made on each of N individuals drawn from a normally distributed population at random, and are plotted as coordinates of N points in p dimensions, the swarm of points tends to have a sort of ellipsoidal shape. If $p=3$, for example, the typical ellipsoid along which the density of probability for these points is a constant may have any shape from that of a sphere to that of a pancake or a needle. In the last cases the distribution may be thought of as approximating a distribution in two dimensions or one. The problem has therefore been propounded more than once of finding a sampling distribution for testing by means of a sample the hypothesis that the distribution is really of fewer dimensions than the number p of variates measured. Such efforts are completely futile. If all the points of a population on which three variates are measured lie in a plane, then every sample from this population lies in the same plane. Conversely, if a sample of more than three points is coplanar, we may conclude that the population is coplanar because in the contrary case the probability of coplanarity of the sample would be zero. Hence there is no problem of a sampling distribution here. But factor analysts have written as though they thought that the deviations of actual observations from the values they compute on hypotheses of smaller dimensionalities could be ascribed to sampling errors. A dubious passage on pages 21–22 of the current volume is perhaps in this category, though another interpretation may also be possible. The reasoning in this passage is, on either interpretation, unsatisfactory.

When it is realized that no deviations from coplanarity, however small, can be explained as sampling fluctuations, it is necessary for the factor analyst determined to represent a number of variates by a smaller number of factors to find some other yardstick for these deviations. One such yardstick, which I suggested in 1933, is provided by the errors of measurement estimated by the reliability coefficients of the tests. Many psychologists, however, have felt that to judge hypotheses by a comparison of the main effect considered with mere errors of measurement is too much like letting the tail wag the dog, and have not used this standard. In order to explain the manifest fact that the dimensionality of the set of observations is actually the number of variates, and no less, they have resorted to highly unsatisfactory "communalities" associated with "specific factors" whose existence does not seem particularly clear on *a priori* grounds, and which is not tested by the statistical methods used.

Another possible yardstick which I also suggested in 1933 is in a theory of the variates themselves as a random sample of a hypothetical aggregate of variates endowed with a probability distribution. This theory has not been developed since then, though it must be essential to the vital problem of finding factors that shall in some sense be invariant when the set of tests used is replaced by a new set. This last question is mentioned, far too briefly, on pages 107–8 of the present volume.

On page 112 a solution is obtained for the coefficients of a general factor in terms of the observed correlations. This appears to be only one of infinitely many solutions of this problem, all satisfying what Fisher calls the criterion of consistency. It provides for the coefficient a statistic that is a function of all the observed correlation coefficients, and in this sense uses all the information in the sample; but it is not clear that it uses all the information in the sample in Fisher's sense of having minimum standard error. Once this problem of obtaining a consistent statistic with minimum standard error is understood, its solution should not be outside the range of reasonably possible straightforward mathematical research; and it is just possible that the solution might turn out to be that given. A related point is that the "least square" criterion on page 115 might well be replaced by minimizing another quadratic form whose matrix is the inverse of the covariance matrix of the triads.

The achievements of factor analysis so far seem to be in the nature of promise, and of challenge to further research in mathematical statistics. Complete methods have not yet been achieved which can be recommended to workers in the empirical sciences without reservation, or with the expectation that they will permanently be regarded as the best possible. Empirical problems, especially in psychology and neighboring fields, will certainly play a part in shaping the direction of the research necessary to put the required methods into final form. But the research will necessarily be a matter of mathematical statistics, for which no combination of psychology and matrix algebra, even with the addition of the other subjects conventionally taught in university mathematics departments, can be adequate unless the progress already made in mathematical statistics itself is utilized.

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SOCIETIES AND MEETINGS

BIOLOGY AND MEDICINE IN THE WAR[1]

IN conjunction with the meetings of the Federation of American Societies for Experimental Biology, the Boston and Cambridge Branch of the American Association of Scientific Workers presented a symposium entitled "Biology and Medicine in the War."

Dr. Maurice B. Visscher, of the department of physiology of the University of Minnesota, discussed the problem of organizing biological research in wartime. Despite the general belief that the present war is the province of the physicists alone, biologists have the opportunity, he said, of making important contributions to the national effort. Not only may biological research aid in lessening the effects of war, but on the offensive side it may assist in solving the problems of combat in desert, tropical or arctic conditions, as well as in determining the factors necessary to elicit maximal performance of fighting men. Dr. Visscher pointed out that while biologists might be inducted into service and assembled in huge central laboratories, such action would delay research while laboratories were being constructed and would seriously deplete the teaching staffs of the universities. He described as short-sighted the view that practical problems should not be attacked until projects have been assigned and contracts drawn up. He emphasized that devotees of pure science should not insist on "research as usual"; on the contrary, scientists as enlightened individuals have a greater responsibility for the national welfare than have other members of the community.

Dr. Carl W. Walter, of the Harvard Medical School, defined six major concerns of war medicine: the control of epidemic disease, the care of the wounded, the organization of civilian preparedness, the acceleration of medical education, the maintenance of adequate nutrition and the coordination of research. The problems of the epidemiologist have been increased by the possibility of rapid transport of the vectors carrying communicable disease from one geographic point to another. War of movement has made necessary a new concept of military medical service, since the surgeon must now follow the mobile forces instead of remaining behind the lines in a base hospital. Other changes in military surgical practice include the insistence upon expert treatment of minor injuries and the emphasis now placed upon methods of treatment which yield ambulatory convalescents. The accelerated program of medical education presents serious problems because it not only requires a return to the strictly didactic type of instruction, but also deprives the student of time in which to mature.

Dr. Lucien Brouha, of the Harvard Fatigue Laboratory and formerly of the University of Liège, discussed the lessons which must be drawn from the attempts to organize biological and medical research in France during the first months of the war. There "secrecy" was imposed to such an extent that no scientist knew exactly what problem he had to solve, nor what progress was being made by other workers engaged in similar research. Lack of liaison between the various laboratories and between scientists and the armed forces was a fatal mistake, repetition of which must be avoided in this country at all costs. Dr. Brouha stressed the necessity of utilizing the scientific power of the nation to the utmost. Quality of the war material and of the soldiers who use it is as important, if not more important, than quantity. While the quality of the material depends upon technical achievements, the quality of the men depends upon the wise use of biological and medical knowledge in their selection, nutrition and care.

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[1] Symposium at a meeting of the Boston and Cambridge Branch of the American Association of Scientific Workers, April 3, 1942.

Dr. Harry Grundfest, of the Rockefeller Institute for Medical Research, called for a cooperative effort on the part of scientists in working out and submitting plans for war research projects. Such an effort by the members of the New York Branch of the association has already brought most satisfactory results. Of these projects the first two to be submitted have already been approved and work has been begun under OSRD authorization. He reported the suggestion that college courses in organic chemistry be reorganized to permit the synthesis by students of chemicals which are likely to become scarce. This project and the scheme for lease-lend of scientific apparatus which has been worked out by the Purdue Branch of the association are other excellent examples of the work which can be accomplished by collective planning.

The discussion which followed served only to emphasize the fact that biologists as a group are dissatisfied with their present relatively inactive part in the war effort. The view that biological and medical research should be "frozen" for the duration was severely criticized; on the contrary, the importance of forming groups for the immediate purpose of planning and organizing war research was repeatedly stressed.

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REPORTS

FIRST REPORT OF THE WAR POLICY COMMITTEE OF THE AMERICAN INSTITUTE OF PHYSICS

REPRESENTATIVES of U. S. Government agencies, institutions of learning, the press and various national associations are turning more and more frequently to the American Institute of Physics for information, advice and cooperation from physicists as a national group. These appeals present opportunities for national service. It falls within the designated scope of the institute to grasp such opportunities, but in order to do so it must first clearly understand the place of the science and the profession in the affairs of the nation and the world. Then it must accept the responsibility of speaking with authority about physics, of reflecting truly the wise consensus of physicists.

The war has brought new problems and rapid changes. It has placed physics in an important position; in fact, its present and potential contributions may well have a profound effect on the course if not the outcome of the war. The institute has thereby acquired the responsibility of keeping abreast of changes, and of presenting to those concerned with the applications of physics and the use of physicists in the war effort a currently valid and accurate portrayal of the science and the profession.

To meet these necessities the institute established a War Policy Committee for Physics, with power to direct the "external" activities in which the institute engages on behalf of the profession. The members of the committee are: Dr. Oliver E. Buckley, president of the Bell Telephone Laboratories; Dr. Karl T. Compton, president of the Massachusetts Institute of Technology; Dr. Homer L. Dodge, dean of the Graduate College, University of Oklahoma; Dr. R. C. Gibbs, chairman of the department of physics, Cornell University, and Dr. Paul E. Klopsteg, president of the Central Scientific Company, *chairman*. Dr. Henry A. Barton, director of the institute, is secretary of the committee.

There follows a report of certain conclusions and recommendations of the committee:

(1) PROFESSIONAL STATUS OF PHYSICISTS

Recent developments in technical and industrial trends have brought physicists into a position of importance in industry not heretofore existing. The present situation requires a more clear-cut definition of "physicist." The War Policy Committee has adopted the following definitions as a basis and guide for its work, and they are recommended to the Founder Societies for adoption:

(a) A *physicist* is one whose training and experience lie in the study and applications of the interactions between matter and energy in the fields of mechanics, acoustics, optics, heat, electricity, magnetism, radiation, atomic structure and nuclear phenomena.

(b) To qualify as a *professional physicist* one must have had at least eight years of training and experience in physics. Toward this experience four years of formal collegiate education with major emphasis on physics may be credited, year for year, if it leads to a bachelor's degree, five years if it leads to a master's degree, and seven years if it leads to a doctor's degree, from a recognized institution. Years of teaching of physics in a recognized institution may be credited as years of experience in physics. By a *recognized institution* is meant one which appears in the list of institutions approved by the Association of American Universities.

(2) TRAINING IN PHYSICS FOR THE WAR

New tools of war have been devised which can swing the tide of victory. They utilize results of research in electronics, electric waves, acoustics, mechanics and optics. Physicists have devised these new tools, engineers have shaped them for manufacture, and manufacturers are producing them. Men are needed to make the best use of them, to test and maintain them, to improve them and to devise new ones. These men are of many kinds, from high-school graduates to doctors of philosophy, but one thing they must have in common—knowledge of the fundamental laws of physics on which the operation of these tools depends.

Training in physics for all these operations and at all these levels is urgently needed.

(3) Emphasis upon the Study of Physics

Even before the war the place of physicists in industry was becoming increasingly recognized. This is made evident by available statistics concerning the growing number of physicists employed in industrial laboratories, and the expanding membership lists of national societies in the field of physics. In the last two years, as a result of war requirements, the need for physicists, as compared with other professions, has grown very rapidly. Recent estimates indicate that the need is now growing at the rate of 1,500 to 2,000 per year, and that the current annual supply from schools is no more than 500. The need referred to applies to individuals having five or more years experience in physics in the sense of Section 1 (b) above (*i.e.*, at least one year of study or experience after the bachelor's degree). It does not include the much larger need for individuals well enough prepared in mathematics and physics for training in technical war operations. This need has been officially estimated at more than 100,000. The War Policy Committee considers this a very conservative estimate.

Accordingly, it is urged upon officers and faculty members of high schools, colleges and universities to recommend immediately that students enroll in courses in fundamental physics and their prerequisites in mathematics, whatever the stage in the student's educational career. The recommendation should be made only to students who possess natural aptitude for these studies. Such guidance for the student will to a marked degree increase his value to his country in this critical time.

Advisers of students may wish to point out to the latter that the study of physics (irrespective of any post-war career) is immeasurably helpful in any walk of life, because such study improves the ability to understand the new physical environment which man is creating for himself, and which, far more even than now, is bound to exert a major influence upon social, political and economic trends.

Moreover, great new developments now appearing behind the veil of war secrecy are, beyond all possibility of doubt, establishing the basis for unprecedented peace-time applications of physics in industry. Some of the greatest of these are along lines not yet developed as branches of engineering. They give promise of opening large and fruitful fields for the useful and profitable employment of those well equipped with a broad, fundamental training in physics.

The committee recommends to high schools that they emphasize mathematics through trigonometry and that in teaching physics the aim should be to give a well-planned, thorough course in the fundamentals of the subject. Unless the high school is properly equipped to offer specialized training in the applications of physics, it should leave this to the higher institutions.

To colleges and universities the committee recommends making provision for the most advanced courses for which students are qualified and, where facilities are suitable, the establishment of intensive courses, with laboratory practice, in electronic devices and high frequency circuits.

(4) Special Training of Physicists

Since the demand for physicists exceeds the supply which can be expected from the normal operations of schools and colleges, this committee endorses the program of special agencies operating to supplement this supply.

(5) Use of Physicists

The need for physicists in the total war effort is so vital, and the demand so greatly exceeds the supply, that it is essential that every available individual trained in physics be placed in a position in which full use is made of that training. The committee therefore would strongly endorse the adoption of any policies and regulations by the Selective Service System, personnel divisions of the Armed Services and other government agencies concerned to achieve this end more effectively.

SPECIAL ARTICLES

THE BIOCHEMICAL SPECIFICITY OF SULFANILAMIDE AND OF OTHER ANTIBACTERIAL AGENTS

Evidence was given from this department[1] which led to the hypothesis that the antibacterial action of sulfanilamide was due to its competitive inhibition of enzymes which normally interacted with *p*-aminobenzoic acid or a closely related substance. The antagonism between these two compounds has now been frequently confirmed, but Johnson,[2] on the basis of a reversal with urethane of the effect of sulfanilamide on luminous bacteria, questioned the hypothesis. We have found that urethane specimens, under certain conditions, may antagonize growth inhibition of *Streptococcus haemolyticus* and *Escherichia coli* caused by sulfanilamide, but that these conditions are limited and illustrate well the reasons for the original hypothesis. The findings are as follows:

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[1] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.

(1) Much more urethane than *p*-aminobenzoic acid is necessary to antagonize the antibacterial action of a given quantity of sulfanilamide (Table I). Thus 1 molecule of sulfanilamide is antagonized by about 1/5,000th of a molecule of *p*-aminobenzoic acid, but between 1 and 100 molecules of urethane were found necessary, and this effect was not reproducible with certainty. It is difficult to picture the mode of action of so small a proportion of *p*-aminobenzoic acid except by a specific enzyme mechanism,[3] but this does not necessarily apply to urethane.

TABLE I

THE DIFFERENT EFFECTS OF URETHANE AND *p*-AMINOBENZOIC ACID

Conditions of testing: *Strep. haem.* (*Group A*) *was grown* as previously described[1] with 10^{-7} *M* pantothenate.

Addenda		Growth after (days)		
Sulfanilamide, $M \times 10^{-5}$	Reversing agent, *M*	1	2	3
0	0	+	+	+
5	0	0	0	+
5	*p*-aminobenzoate, 2×10^{-8}	+	+	+
5	*p*-aminobenzoate, 4×10^{-9}	0	+	+
5	urethane, 10^{-2}	0	+	+
5	" 5×10^{-3}	0	+	+
5	" 5×10^{-4} and less	0	0	+
10	0	0	0	0
10	*p*-aminobenzoate, 4×10^{-8}	+	+	+
10	*p*-aminobenzoate, 4×10^{-9}	0	0	+
10	urethane, 5×10^{-2} to 5×10^{-4}	0	0	0
50	0	0	0	0
50	*p*-aminobenzoate, 4×10^{-7}	+	+	+
50	*p*-aminobenzoate, 8×10^{-8}	0	0	0
50	urethane, 5×10^{-2} to 5×10^{-4}	0	0	0

(2) The urethane antagonism was shown only towards low concentrations of sulfanilamide, which were just anti-streptococcal. With slightly different concentrations the urethane had no reversing activity or was inhibitory. Five times this limiting concentration of sulfanilamide was not antagonized by many times the concentration of urethane. The urethane effect thus can not be said to parallel that of *p*-aminobenzoic acid, which can be effective against 50 times such a concentration of sulfanilamide. More *p*-aminobenzoic acid is needed to antagonize such higher concentrations of sulfanilamide, the quantities being roughly proportionate. The constancy of the ratio Cs/Cp, where Cs is the minimal concentration of sulfanilamide necessary for bacteriostasis in the presence of a concentration Cp of *p*-aminobenzoic acid, is *consistent with sulfanilamide acting by inhibition of* an enzyme normally reacting with *p*-aminobenzoic acid. Their similarity in structure makes this feasible. *The non-competitive type of antagonism* shown by urethane specimens is already known to be given by methionine,[4] which is structurally entirely unrelated to sulfanilamide. It has, however, been indicated by Harris and Kohn[4] that this action is consistent with *p*-aminobenzoic acid being the compound primarily affected by sulfanilamide. Methionine is regarded as biochemically related to *p*-aminobenzoic acid in that the acid is necessary for the normal production or metabolism of methionine.

No mechanism is suggested for the action of urethane. Antagonistic effects of inhibitory compounds are, however, well known under the term "chemotherapeutic interference." Cases of such interaction which have been investigated are, like the effects with narcotics quoted by Johnson,[2] not necessarily between structurally related compounds. Specific biochemical mechanisms can, however, be given,[5] such as the inactivation of hydrogen transporting systems by acriflavine and their replacement by methylene blue. This is in distinction to the suggestion[2] of promiscuous interaction between inhibitors and illustrates the general tendency to biochemical definition of pharmacological action rather than *vice versa*. An approximation to biochemical localization of narcotic action has been made by Michaelis and Quastel.[6]

(3) Other antibacterial agents are now known which in the manner of sulfanilamide are related to

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[2] F. H. Johnson, SCIENCE, 95: 104, 1942.

[3] This large difference between the interacting quantities of *p*-aminobenzoic acid and sulfanilamide has been given as an argument against a competitive mechanism for the action of sulfanilamide (S. D. Rubbo and J. M. Gillespie, *Nature*, 146: 838, 1940) and has been repeatedly quoted as such (*e.g.*, by Johnson). The argument is now abandoned or no longer emphasized by its authors (*cf.* S. D. Rubbo and J. M. Gillespie, *Lancet*, I: 36, 1942) and is in fact no objection to, but is best interpreted in terms of competitive enzyme inhibition.

[4] H. I. Kohn and J. S. Harris, *Am. Jour. Physiol., Proc.*, 133: 354, 1941; E. Strauss, J. H. Dingle and M. Finland, *Jour. Immunol.*, 42: 313, 1941; J. S. Harris and H. I. Kohn, *Jour. Pharmacol.*, 73: 383, 1941.

[5] N. von Jancso and H. von Jancso, *Z. Immunforsch.*, 88: 275, 1936; H. McIlwain, *Biochem. Jour.*, in press; summarized in *Lancet*, 2: 762, 1941.

[6] M. Michaelis and J. H. Quastel, *Biochem. Jour.*, 35: 518, 1941.

growth essentials. The "narcotic" hypothesis gives no expectation of mutual specificity between their effects. Such does, however, exist (Table II) and is readily explained in terms of competitive enzyme inhibition. Thus the inhibition by pyridine-3-sulfonamide is unaffected by the presence of *p*-aminobenzoic acid or pantothenic acid, but is antagonized by a definite fraction of its concentration of nicotinic acid. Pantothenic acid, but not nicotinic or *p*-aminobenzoic acids, reverses the inhibition due to pantoyltaurine.

TABLE II

Specificity of Antibacterial Agents

Organism and reference to conditions of testing	Addenda		Growth
	Inhibitor, *M*	Metabolite, *M*	
Strep. haem.[1] *Bact. coli*[8]	0	0	+
	sulfanilamide, 3×10^{-4}	0	0
	"	*p*-aminobenzoate, 10^{-7}	+
	"	pantothenate[11], 10^{-7} to 10^{-4}	0
	"	nicotinamide[11], 10^{-7} to 10^{-4}	0
Staph. aureus[9]	0	0	+
	pyridine-3-sulphonamide, 10^{-3}	0	0
	"	*p*-aminobenzoate, 10^{-7} to 10^{-4}	0
	"	pantothenate, 10^{-7} to 10^{-4}	0
	"	nicotinamide[11], 10^{-5}	+
Strep. haem.[7] *Diplococcus pneumoniae*[10] *C. diphtheriae*[10]	0	0	+
	pantoyltaurine, 10^{-4}	0	0
	"	*p*-aminobenzoate, 10^{-7} to 10^{-4}	0
	"	pantothenate[11], 10^{-6}	+
	"	nicotinamide[11], 10^{-7} to 10^{-4}	0

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THE EFFECT OF INSULIN SHOCK ON LEARNING IN THE WHITE RAT

Since its introduction by Sakel, insulin shock has been successfully used in the treatment of certain cases of dementia praecox and allied psychiatric and psychoneurotic conditions to bring about a remission of the symptoms which in certain cases has lasted indefinitely. There has been, as yet, no agreement as to the theory of its action, although there is no doubt that a cerebral anoxia is produced, with which the therapeutic effect is associated and upon which it is probably dependent. It occurred to one of us that the psychopathological symptoms might be regarded as recently formed habits of response, with younger and metabolically more unstable synaptic patterns of neuronal associations involved. If this were true, the more recently formed habit pattern should be more easily broken up, because of the effects of the cerebral anoxia. It was decided to test this hypothesis by observing the effect of insulin shock on habit formations in the experimental animal.

This is a preliminary report of a study involving the effect of insulin shock on habits of varying degrees of stability and age in the white rat. Exploratory observation established a tentative optimum dosage as one unit of insulin per 12 grams of body weight. In the exploratory group of animals, this medication caused a state of lethargy and/or coma lasting about two hours with a latent period of approximately 40 minutes. In almost half of the cases, there occurred severe convulsive seizures in which movements of the head region were particularly pronounced. All animals seemed to be normal within eight hours after injection.

Two mazes differing in complexity and type constituted the bases for the learning situations. The first group of animals began on a multiple-unit, elevated T maze. When this had been mastered to a criterion of 9 perfect runs in a sequence of 10 trials, 100 additional runs were made. Upon completion of this overlearning, training was begun on a linear arrangement of the Warner-Warden multiple-unit alley maze. The same criterion of learning was used, but the additional overlearning was omitted. During the learning of the alley maze no practise was given on the elevated maze. As soon as an animal had learned both mazes it was given 20 trials on each maze separately. Any animal making more than two errors in this stage was discarded. Following the test period, each rat was injected with the appropriate dose of insulin. Twenty-four hours after injection, the animal was again given 20 trials on each maze. A similar procedure was followed for the second group except that training was begun on the alley maze and the elevated maze habit was made the younger and less well-established habit. All rats were males.

The results are given in the appended table. It will be noted that, because of the rotation of groups, the first six animals who began their training on the elevated maze are found in the lower right side of the table, when the newer or alley habit is considered. That is, rat No. 1 began on the elevated maze and continued on the alley maze, whereas rat No. 7 reversed this procedure.

The present report will deal only with comparisons in terms of total errors during the pre-post-shock test periods and on the learning of new and old habits. The means for the various groups are as follows:

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[7] H. McIlwain, *Brit. Jour. Exp. Path.*, 20: 330, 1939.

[8] P. Fildes, *ibid.*, 19: 239, 1938.

[9] H. McIlwain, *ibid.*, 21: 136, 1940.

[10] H. McIlwain, *ibid.*, in press; summarized in *Chem. Ind.*, 61: 96, 1942.

[11] Low concentrations of these compounds are in some cases necessary for growth, and were then present in the inhibited cultures; further quantities (those quoted) were necessary for reversal.

Older habits

Elevated maze, pre-shock, .33, post-shock, 6.0
Alley maze, pre-shock, .83, post-shock, 4.83

Newer habits

Elevated maze, pre-shock, .50, post-shock, 11.00
Alley maze, pre-shock, .50, post-shock, 15.33

The conclusions from the above results seem to point to a more severe impairment of the newer and less overtrained habits. This statement is bolstered by the small size of the differences between the various habits during the pre-shock test period. Using Fisher's T test to determine the significance of the obtained differences we find that neither of the comparisons between the pre-shock tests are of statistical reliability. The P values for these differences are between .7 and .9.

The P values for the comparisons between the new and old habits in terms of post-shock differences are .075 for the elevated maze and less than .01 for the alley maze. *In other words, the insulin shock seems definitely to impair the learning of a recently acquired alley maze habit and probably to impair the learning of a recently acquired elevated maze habit.* No definite impairment can be found for the learning of older habits either on the elevated or alley maze.

TABLE I

EFFECT OF INSULIN SHOCK ON ERROR SCORES OF RATS

Elevated maze (old habit)			Alley maze (old habit)		
Subject number	Pre-shock errors	Post-shock errors	Subject number	Pre-shock errors	Post shock errors
1	0	8	7	1	3
2	1	6	8	1	6
3	1	9	9	1	4
4	0	5	10	0	4
5	0	5	11	2	10
6	0	3	12	0	2
(new habit)			(new habit)		
7	0	5	1	1	10
8	1	15	2	0	12
9	0	6	3	1	11
10	0	18	4	0	24
11	0	12	5	0	16
12	2	10	6	1	19

Each entry under "errors" represents the sum of 20 trials.

In the psychiatric conditions in which insulin shock has been employed, the symptoms are relatively recent cerebral manifestations as compared with the behavior acquired during the pre-morbid phases of the individual's development. These results with the experimental animal would seem to confirm our hypothesis of their relative susceptibility to metabolic shock applied to the cerebral patterns behind them. We are continuing our experiments and shall carry out similar ones with metrazol shock and electro-shock which also produce their therapeutic effects by the production of a cerebral anoxia.

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TOXIN FORMATION BY CERATOSTOMELLA ULMI

SINCE the discovery of the Dutch elm disease, caused by *Ceratostomella ulmi* (Schwarz) Buisman, in 1919, gums and tyloses have been observed commonly plugging xylem vessels of affected elm trees.[1, 2] It has been assumed that wilting and decline of diseased elms are entirely the result of a "drouth" reaction, caused directly by the plugging of the vessels.

In the case of many vascular diseases of plants the concept that wilting and necrosis result primarily from plugging of xylem elements with hyphae, gums and tyloses has been largely replaced during the past twenty years by evidence that a toxin is the primary disease factor. Many of the fungi causing this type of disease, as well as other pathogenic fungi, have been shown to produce toxic substances which, on being transported upward in the vessels, can cause symptom appearance considerably in advance of the pathogen. Linden, Zenneck and Gunther[3] and Clinton and McCormick[4] have speculated that the symptoms produced by *Ceratostomella ulmi* might be the result of toxin production, but these authors did not present experimental evidence.

As the result of experiments begun here in 1940 it has been found that *C. ulmi* in culture produces a soluble toxic substance which is evidently the primary factor in the production of Dutch elm disease symptoms. This toxin is produced when the fungus is grown on a liquid nutrient solution containing yeast extract in addition to other nutrients. The fungus grows very poorly on the standard liquid synthetic media, but good mat formation is obtained when essential growth factors are provided by adding yeast extract, as in the following solution: KH_2PO_4 1.5 g., $MgSO_4 \cdot 7H_2O$ 1.0 g., $FeCl_3$ 0.01 g., asparagin 2.0 g., dextrose 30 g., Bacto yeast extract 2 g. and distilled water 1,000 cc.

Toxicity is tested by filtering off the fungus, after 12 to 25 days growth on the nutrient solution, injecting the sterile filtrate into small American elm trees, and testing its effect on various plant cuttings. When the toxin was freed of the fungus by Berkefeld filtra-

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[1] M. G. Schwarz, *Meded. Phytop. Labor. Willie Comm. Scholt. Baarn*, 5: 74 pp., December, 1922.

[2] C. J. Buisman, *Tijdschr. Nederl. Heidemaatsch.*, 40: 338–345, October, 1928.

[3] G. V. Linden, L. Zenneck and Gunther, *Centralbl. Bakt. Abt.* II, 69: 340–351, February 28, 1927.

[4] G. P. Clinton and F. A. McCormick, *Conn. Agr. Expt. Sta. Bull.*, 389: 697–752, October, 1936.

tion and injected into healthy elm seedlings, typical symptoms of the Dutch elm disease appeared. Young leaves wilted and died, older leaves curled upward or developed necrotic spots; cell walls were discolored for long distances from the injection hole and dark gums appeared to plug the vessels. Tomato, elm, snapdragon and maple cuttings placed in tubes containing the filtrate from fungus cultures wilted severely, usually in from one to four hours. Uninoculated nutrient solution did not affect elm trees or plant cuttings, nor did control solutions adjusted to the pH of the fungus filtrate.

Five potted elms in the greenhouse and 10 elms three to four feet tall growing in nursery rows were injected with filtrate from a 25-day-old culture. Within three days the above-mentioned symptoms appeared on all trees. An average of 20 per cent. of the leaves were killed, and the average height to which the wood discoloration extended above the injection hole was 24 inches on five trees injected with 75 cc of filtrate; comparable figures for five trees injected with 200 cc of filtrate were: 29 per cent. leaf kill and 29 inches for the average height of discoloration. Tests on the time factor in relation to toxin production showed slight toxin formation after three days growth of the fungus and optimum production after a 12-day incubation period. As expected, toxin production is closely related to vigor of growth of the fungus culture.

Thermostability of the toxin after boiling for five minutes indicates that it is not enzymatic. The toxin is adsorbed by activated charcoal, is removed from aqueous solution by an excess of toluene and is antidoted by several organic chemicals.[5] Further work on the identity of the toxic substance is in progress.

Thus it has been demonstrated that symptoms similar to those of the Dutch elm disease can be reproduced by injecting a sterile filtrate from cultures of the fungus. This indicates that the same type of reaction takes place in the tree and that wilting and necrosis of leaves and discoloration of the wood are a response to the fungus toxin produced in the tree in the same way as they are to the fungus toxin produced in culture. As infection develops and more toxin is formed, gum and tylosis formation undoubtedly increases until the plugging of vessels becomes the important secondary disease factor. As a result of this plugging, water conduction may be shut off entirely and the tree dies unless new wood can be formed.

If, as these results indicate, *C. ulmi* is effective in killing elm trees primarily because of toxin production, several different approaches to attempted control of the disease by chemotherapy are indicated. As stated recently,[5] it may not be necessary to attempt to *kill* the pathogen by chemotherapy. This has been the prevailing endeavor in the past, but if the fungus toxin can be antidoted for a sufficient time by injection of a suitable chemical, the tree may outgrow and wall off the infection, particularly in a vascular disease of this type. Thus the chemical nature of the toxin becomes important in selecting chemicals which may affect it in the diseased plant. Chemotherapy, of course, can also attempt to affect the processes causing toxin production, by injecting chemicals with the aim of directly interfering with some phase of metabolism of the pathogen.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PHOTOELECTRIC MEMBRANE MANOMETER*

THE device to be described was designed for the purpose of making an accurate record of the pressure changes in the cardiovascular systems of various animals, especially the dog and turtle. Probably the most successful method has been used by Wiggers[1] and others, who have had good results with it in the dog. This method uses a membrane manometer similar to that shown, except that a complicated adjusting mechanism is necessary. The light source is a powerful carbon arc focused on the mirror, and the light reflected must be projected fifteen feet to a moving strip of photographic paper. This great distance is needed to provide sufficient optical magnification. Auricular pressures in the turtle would be almost impossible to record with this instrument. Because of the inconvenience of the method, its lack of sensitivity and the difficulty of making simultaneous cathode ray oscillograph records of the electrical changes on the surface of the heart it was decided to try to find some electronic means of pressure recording.

Several methods seemed promising, among them the variable resistance devices, on which Edison took out dozens of interesting patents in his search for a practical microphone. These devices were not sufficiently stable to return to the base line when the pressure was removed or had some other disadvantage. The piezoelectric pressure recorders will not record accurately a sustained pressure increase. Using the diaphragm as a condenser microphone has the same objection.

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[5] J. G. Horsfall and G. A. Zentmyer, 17th Proc. Nat. Shade Tree Conf., pp. 7–15, 1941.

* Supported in part by a grant from the Wisconsin Alumni Research Foundation.

[1] C. J. Wiggers, "The Pressure Pulses in the Cardiovascular System." New York: Longmans, Green and Company. 1928.

If, however, the changing capacitance be used to frequency modulate an oscillator tuned to the sharply sloping portion of the selectivity curve of an intermediate frequency amplifier, and the amplifier output rectified by a diode, the rectified voltage will be in effect a directly coupled function of the voltage. This method was tried and worked quite well, but was abandoned because of mechanical difficulties in making a condenser microphone small enough to go into the heart. The principle has been used in a myograph, which will be described in a later article.

The method finally used is shown in the diagram (Fig. 1). The various parts are mounted on a triangular piece of one-half inch steel. The light source is a 75-watt exciter lamp of the type used in sound-on-film motion picture projectors. A single lens is used to focus the light on the mirror, which reflects a cone of light toward the photocell, an RCA 921 or 922. The apparatus is so adjusted that with zero pressure a small part of the light falls on the photocell. As the pressure applied to the diaphragm increases, the mirror is deflected and more light falls on the photocell. This produces an electrical change which is amplified by a push-pull direct coupled amplifier[2] and causes a deflection of the cathode ray spot, the amplitude of which is controlled by varying the gain of the amplifier.

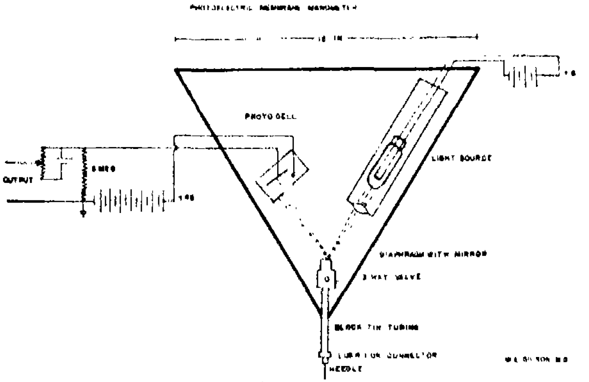

FIG. 1.

The entire pressure system is filled with citrate solution. The three-way valve provides for connection between the diaphragm chamber and the side arm, for calibration against a mercury column, between the diaphragm chamber and the needle for record taking, and between the side arm and the needle for washing out the pressure system.

The output is linear over a wide range, as determined by accurate calibration. The device is easily adjusted and very flexible. It may be used to record the 160 mm Hg pressure change in the dog ventricle or the 1 mm Hg change in the turtle auricle. To my knowledge the latter has not been accurately recorded previously.

The frequency response is good, and entirely dependent on the mechanical design of the membrane manometer. This design is discussed by Wiggers.[1] The first part of his book would be of value to any one interested in using an instrument of this type.

The results and records obtained may be seen in papers by Eyster, Meek and Goldberg.[3, 4]

The photoelectric membrane manometer is not restricted in its application to cardiovascular research, but should be of value in a wide variety of physical and engineering problems.

In summary, its advantages over optical projection are:

1. Greater sensitivity.
2. Variable sensitivity. Pressure changes of any magnitude may be represented by any desired deflection of the cathode ray spot, simply by changing the amplifier gain.
3. Electrical changes may easily be recorded simultaneously.
4. Insertion of the needle is easy, because the entire device may be moved as a unit to any position desired.
5. It is not necessary to work in a room twenty feet in length.

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[2] H. Goldberg, "Electrical Engineering," January, 1940, Trans. p. 60.

[3] H. Goldberg and J. A. E. Eyster, *Am. Jour. Physiol.*, 131: 416, 1940.

[4] J. A. E. Eyster, Walter J. Meek and Harold Goldberg, *Am. Jour. Physiol.*, 131: 760, 1941.

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INDICATIONS AS TO CLIMATIC CHANGES FROM THE TIMBERLINE OF MOUNT WASHINGTON[1]

By Dr. ROBERT F. GRIGGS

NATIONAL RESEARCH COUNCIL

We stand on historic ground. The arctic plants of the Alpine Garden, here isolated on Mount Washington, played a decisive role in establishing Plant Geography as a science; and this science was the crucial point on which turned the acceptance of the doctrine of Evolution. In the years before 1859 progressive naturalists were seeking an answer to the riddle of the Origin of Species. No aspect of this problem was so vexing in those days as the question raised by species with disjunct distribution. Had there been two acts of creation resulting in identical species, one in each of the separate ranges? or was the present dispersal the result of immigration from a single original center? It was the answer to this question which finally disposed of the doctrine of special creation in the minds of Darwin and his associates. Feeling the need of additional data on this question, Darwin asked his friend, Asa Gray, to discuss the relationships of our eastern flora. Gray did so under the unpretentious title of "Statistics of the Flora of the Northern States."[2] In a second paper, still antedating the "Origin" he amplified and strengthened the theoretical opinions cautiously expressed in the first.[3]

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[1] Address given at the Symposium on Alpine Ecology, Ecological Society of America, Mount Washington, June 26, 1941.

[2] *Am. Jour. Sci.*, Ser. 2, 22: 23, 1856–57.

[3] "On the Botany of Japan." Mem. Am. Acad. Arts and Sciences, 6: 443 *et seq.* (Read December 14, 1858,

You will wonder how the isolated occurrence of a few arctic species here could have any great significance. We in this generation, indeed, expect as a matter of course to find arctic species in alpine habitats. It is hard for us to see the point of view of the naturalists of 85 years ago. The theoretical spectacles through which pre-Darwinian scientists had to look at the world, however, made it more difficult to understand small outlying stations far from the main body of the range of common species than the occurrence of distinct endemic species limited to single stations.

The scientists of those days were struggling with the belief not only that species were created as they now are but where they now are, *i.e.*, confined to their present habitats and in substantially the same numbers as they are to-day. Listen to Gray[3] on the difficulty of this question:

> The fundamental and most difficult question remaining in Natural History is here presented:—The question whether this actual geographical association of congeneric and other nearly related species is primordial and, therefore, beyond all scientific explanation, or whether this may be *to a certain extent* (ital. mine) a natural result. The only noteworthy attempt at a scientific solution of the problems, aiming to bring the variety as well as the geographical association of existing species more within the domain of cause and effect, is that of Mr. Darwin and (later) of Mr. Wallace—partially sketched in their short papers, "On the tendency of Species to form varieties and on the perpetuation of Varieties and Species by means of Selection, in the *Journal of the Linnaean Society*, Vol. 3 (Zoology), page 45." . . .
>
> Professor Agassiz maintains, substantially, that each species originated where it now occurs, probably in as great a number of individuals occupying as large an area, and generally the same area, or the same discontinuous areas as at the present time.

But, as Gray pictured the situation:

> . . . At length—the glacier epoch came slowly on—The change was so gradual that it did not destroy the temperate flora, which . . . must have been pushed on the lower latitudes as the cold advanced; and between them and the ice there was doubtless a band of subarctic and arctic vegetation—portions of which retreating up the mountains as the climate ameliorated and the ice receded, still scantily survive upon our highest Alleghanies and, more abundantly upon the colder summits of the mountains of New York and New England:—demonstrating the existence of the present arctic-alpine vegetation during the glacial era.

That is to say, before Gray's challenge, men felt that they had to believe that the many arctic species which are found in the alpine zone of the Presidential Range required an especial visit of the Creator to produce them, there! Outlying colonies of plants and animals far from the main body of their ranges are among the common phenomena of nature. No two outlying stations preserve exactly the same set of relicts. So it is easier to understand how confusing, not to say irrational, the acts of the Creator appeared to would-be interpreters of nature before Gray boldly declared:[3]

> I cannot resist the conclusion that the extant vegetable kingdom has a long and eventful history, and that the explanation of apparent anomalies in geographical distribution of species may be found in the various and prolonged climatic or other physical vicissitudes to which they have been subject in earlier times.

I need hardly add that, though we are now convinced that an adequate knowledge of the history of such cases would bring complete understanding of them, we are still very far from having unravelled the tangled events involved. We are assembled here today, largely to take stock of the progress of that quest from the angles represented by the workers in different fields here present. We know that we shall learn of notable things that others have accomplished, each in his own specialty. Perhaps, from this day's exchange of information and ideas, we can to advantage map our future efforts.

I may begin by stating, what is familiar to all of you, that the very general terms of Asa Gray's original *Glacial Relict Theory* are by no means detailed enough to satisfy the scientific curiosity of those who have later sought to interpret the plant geography of northeastern America. Relict species have, rather, continued to be a matter of discussion down to the present day. The most extensive expression of that interest is to be found in the many papers of Professor Fernald and others, elaborating and discussing the "Nunatak hypothesis."

In addition to such arctic plants as those growing around us here in the "Alpine Garden," there are isolated in northeastern America tiny outliers of many other species, the main body of whose ranges lie elsewhere, often not at all in the arctic. The "Nunatak hypothesis" supposes (1) that these species survived the last (Wisconsin) glaciation by persisting on areas which, though surrounded by the continental glacier, were not covered by ice, like the nunataks standing above the Greenland ice-sheet of to-day; and (2) that since the Wisconsin glaciation they have for the most part remained confined to their nunatak refuges. The existence of a notable collection of such plants is taken as prima facie evidence according to this view that their habitat was free from ice and otherwise favorable for plant life through Wisconsin times, *e.g.*, the Keewanaw Peninsula of upper Michigan.[4]

An essential feature of these relict theories is that

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and January 11, 1859.) ("The Origin of Species" was published on November 24, 1859.)

[4] M. L. Fernald, *Rhodora*, 37: 197–228, 1935.

they envisage conditions as static. To be sure, they do recognize that the invasion of the ice sheet had caused readjustments of the flora in the dim geologic past. But they take little specific account of plant migrations since the glaciation.

Until the last decade or two there has been a great gulf fixed in men's minds between geological time and historical time. Changes in climate since the last ice age were discussed at the International Geological Congress at Stockholm in 1910, the opinion was then expressed that the deterioration of climate in Scandinavia shown by late Pleistocene deposits might likely be continuing into the present. But no means were discovered of testing this opinion by evidence.[5] Since 1910, however, notable progress has been made in connecting the geological past with the historical past.

We should look at these arctic plants here hanging on and at these trees here stretching up the mountain slopes as mute indicators of climatic trends and we should seek to unravel their story. The tension zone between subalpine forest and alpine tundra ought to be one of the most favorable of all places to discover what is going on. Specifically, are these dwarfed and crippled trees, in whose shelter you crouch as you listen, advancing up the mountains under conditions still improving since Wisconsin times or are they being beaten back by a worsening climate?

This timberline differs markedly from those of Western America. On the arctic timberline in Alaska the trees are not deformed in any way but, as studied especially at Kodiak,[6] are normal spire-shaped conifers and maintain a reproduction and rate of growth comparable with that of the same species a thousand miles inside the arctic border. Here there is conclusive evidence, botanical and historical, that the trees are advancing into the tundra. We conclude that climate is improving in Alaska.

In the Northern Rocky Mountains the uppermost trees are recumbent and their growth is reduced, but very old trees, erect and undwarfed, occur close to extreme tree line, and the trees commonly retain their full size up to or beyond the point where the forest begins to thin out and give way to open meadow so that one may usually walk with ease through the forest at timberline in any direction. Conditions here convinced me that in this area timberlines have been static for a number of centuries.[7]

In the White Mountains the forest begins to be stunted 2,000 feet below the timberline. The trees become shorter and denser with ascent until, still retaining the erect arborescent form, they form a compact level-topped elfin forest over the top of which you may sometimes walk but which you can penetrate only by chopping your way. Above this scrub, the trees, still further dwarfed, form in places extensive carpets close-clipped by wind and snow blast. These appear from a little distance like well-kept lawns. In the most extreme of these, all tendency to form upright leaders is suppressed and only lateral branches are produced.

Second, the trees on the exposed portions of the Presidential Range and to a considerable extent elsewhere in the White Mountains are confined to specially protected situations such as the lee of a bowlder. Old trees come finally exactly to fill a streamlined outline matching the flow lines of the prevailing wind around the projecting bowlder. The winds at Kodiak do not deform the trees at all, and in the western mountains such excessive wind action is rare and local. There clumps of trees may, indeed, be differentially dwarfed and wind-shorn on the windward side (see photographs[7]), but they often stand in the open without protection.

Third, seedlings or young trees of the conifers are rare near tree line in the White Mountains. But on the western mountains seedlings of fir and spruce are readily found up to and beyond the last of the established trees. Most of these, as would be expected, grow a few years and then succumb. At Kodiak seedlings are not only common, but vigorous and persistent, providing the means for the active migration into the Arctic. The absence of seedlings on the heights of the Presidential Range is not due to any scarcity of seed—every bank at favorable levels in the forest and well into the zone of dwarfing is covered with seedlings. Nor is it due to lack of wind to scatter the seed over the alpine zone—the winds on Mount Washington are second to none.

The seeds of fir and spruce which lodge in the alpine zone of the White Mountains must, with rare exceptions, be killed as they germinate.

Trees are now occupying a rather wide zone on these mountains which they could not colonize under present conditions. They hang on by virtue of the freedom with which they spread by putting out roots along their prostrate trunks. Because of this habit trees can persist indefinitely without reseeding, continuously rejuvenating the tips while dying behind. It is not at all uncommon to find a prostrate tree whose distal, younger portion is larger than the proximal, older part by reason of growth supported by adventitious roots. Thus there may be more rings in the younger portion of a trunk than in the older. The real age of such a "tree" can by no means be ascertained from the number of rings in its trunk. Some of these prostrate cripples have probably persisted for centuries.

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[5] Gunnar Andersson, "Veränderungen des Klimas seit dem Maximum der Letzen Eiszeit," 11th Int. Geol. Cong. Stockholm, p. 292, 1910.

[6] R. F. Griggs, *Ecology*, 15: 80–96, 1934.

[7] *Idem*, *Ecology*, 19: 548–564, 1939.

We must ask ourselves now how the trees above the zone of seedlings ever became established. The simplest explanation and, I believe, the true one is that the upper trees on Mount Washington are hold-overs from a time of more hospitable climate when seedlings could start in places where they are now killed off.

The next question is whether the highest trees under these conditions are holding their own in spite of the lack of reinforcement, so to speak, by new seedlings. To answer, the differences in reproductive condition between this and normal forest must be brought out. In normal forests, even in many of the patches of upright trees high up on the Presidential Range, all stages occur: seedlings, saplings, mature trees, dead stubs, decaying logs; some are vigorously adding new wood year by year, others are standing nearly still, others, at the limit of their life span, slipping backward and the proportion of dead wood to live, increasing.

But among these crippled trees distinctions between youthful vigor and decrepit age appear more between the parts of a single tree than between different trees. Prostrate branches covered with snow through the winter and rooting freely maintain indefinitely the condition of youth and, barring accident, can spread for long periods. But, whenever these snow-covered mats send up vertical shoots, they begin to suffer. The upright trunks in the transition zone between forest and prostrate carpets are the best indicators which way the balance is tipping.

On most of these trees the branches of the live uprights have been slowly diminishing for a number of years. This does not mean that upright growth is stopped. Supported by the large mat of recumbent branches at the base, the leaders of a timberline tree will often make strong growth year after year—I have measured 17 inches. But on balance, winterkilling nearly always exceeds growth. For example, one tree on Osgood Ridge had a dead trunk about six feet tall. Directly to lee of this was a second leader which, though sheltered by the older trunk, had attained a height only about four fifths as great. Yet it had reached its limit and was on the point of death, only a few small twigs remaining alive. Further to lee was a shorter oblique shoot about two feet high which remained healthy.

Such a tree presents a diagrammatic picture of what appears to be happening generally: The trees seem to be in process of being forced into more and more recumbent positions.

In a few places, where the old forest was killed back half a century or more ago by some catastrophe, probably fire, there remain stumps of old trees larger than any that now grow on the sites. The new trunks that have come up since have now reached their limits and are held at sizes somewhat less than half the originals.

One of these is on the lee side of Osgood Ridge, where a narrow tongue of trees reaches up from the forest into the alpine zone. At the tip of this tongue are two picturesque repeater trunks, standing above the subprostrate snow mat. The largest of these measures 5 inches in diameter. It has made 20 successive attempts to push up a leader. Immediately in front of it stands a shell of a predecessor trunk which was 12 inches thick.[8]

These large old stumps again are difficult to interpret except as indicators that the climate on Mount Washington has grown worse for trees within the last century.

But changes in climate are regional rather than local. Before we can draw conclusions from the retreating timberline of Mount Washington, we must look further afield. Scattered through the literature is a good deal of evidence that the climate of northeastern America has changed considerably during the last thousand years. Fortunately these have been brought together by Raup,[9] first for New England and New York and later as a part of a more general review.[10] Evidence from many sources indicates a very definite worsening of climate during the latest centuries over all northeastern America from New York northward. Perhaps the best-attested and certainly the best-dated of these evidences is the gradual freezing out of the old Norse Colonists of Greenland. Accounts indicate that the new Green land, discovered by Lief Ericson in the tenth century, offered considerable advantages over Iceland as a home for European colonists. The Norse colony in Greenland, supported by dairy farming and exports of cheese to the mother country, had a prosperous existence until the latter part of the twelfth century. The Norsemen hung on in Greenland until the fifteenth century, but increasing rigor of climate caused a pitiful decline and final extinction. The recent excavation of this colony has brought to light physical facts which abundantly corroborate the old records of increasing ice in the sea and similar difficulties. Perhaps the most significant of these physical evidences is the fact that the colonists lie buried in soil which is now perpetually frozen. Yet their coffins and even the marrow of their bones are permeated by tree roots. Since tree roots can not penetrate frozen soil, these must have grown before the ground froze up, *i.e.*, in a period with a milder climate than the present.[11]

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[8] These and other features of timberline on Mount Washington will be described in detail in another place.

[9] Hugh M. Raup, *Jour. Arnold Arboretum*, 18: 79–117, 1937.

[10] *Bot. Rev.*, 7: 209–248, 1941.

Fitting in with these human records is the fact, commented on by many botanists, that plants of Greenland seldom ripen seed under present climatic conditions, though the same species are fully fertile in more hospitable climates.

Several observers[10] report that the arctic timberline in northeastern America is retreating, *viz.*, "West of Hudson's Bay," by Sir John Richardson and Johannsen,[10] "East of Hudson's Bay," by Abbe.

The situation on the north shore of the Gulf of St. Lawrence is discussed by Marie Victorin.[12] The record of Jacques Cartier indicates a wider extension of forest near the Straits of Belle Isle in 1534 than at present, but the geographical reference is rather vague. However, Fernald[13] has recorded stumps a foot in diameter at Blanc-Sablon, where to-day is only moss and bog. Likewise there are a number of puzzling relicts of southern plants in this region which point to a former period of warmer climate. These facts caused Marie Victorin to remark, "One could perhaps go further and ask himself if the present spruce forest of the north coast, of Anticosti and elsewhere is not irretrievably doomed, maintaining itself only by virtue of the mutual protection the trees give each other and whether if once destroyed over a large area this forest would be able to reconstitute itself."

It has been suggested, not infrequently, by those considering the evidence of deteriorating climate that another glacial period may be coming on. The evidence in our possession does not justify so strong a statement. All that is proved is that climate in our part of the earth is undergoing a prolonged deterioration in terms of human history. We do not yet know enough of climatic change to distinguish variations of merely historical importance from those of geological consequence.

The geological implications of the worsening of climate being experienced in northeastern America lie rather in another direction—in their bearing on the problem of the correlation of ice ages. Were the Pleistocene glaciations of the northern hemisphere simultaneous throughout, or did the centers of the ice-sheets shift about so that first one area was glaciated, then another? It is the current belief of geologists that the Wisconsin glaciation of America and the Würm of Europe were synchronous. But it should be remembered that, despite the remarkable work that has been done in following the retreat of the ice year by year through study of the varves, there are in America breaks in the varved record which prevent the assignment of definite dates. The character of the gaps in the sequence and the irregularities in the rate of melting of the ice over the area where the sequence is complete preclude any estimate of the time periods covered by the breaks in the record and so of any definite correlation with events in Europe. Kirk Bryan[14] has recently remarked in this matter:

> Unfortunately, there is no absolute proof that glaciation was synchronous over the earth. The synchroneity is at best a doctrine supported by: . . . These arguments when set down seem weak indeed. On the other hand, there is no valid argument to the contrary. . . .

On the principle that the simplest hypothesis possible should be invoked to explain any phenomenon, a theory of alternative continental glaciation is preferable to one of total hemispheric refrigeration. The latter requires some drastic change in the amount of radiation supplied to the earth. But local glaciations covering merely parts of continents such as that of Greenland to-day require merely shifts in the positions of present climatic provinces.

It is indeed a matter of primary importance for the interpretation of glaciation to remember that the Pleistocene ice sheets were always largely restricted to western Europe and northeastern America. In neither northwestern America nor northern Asia was glaciation so well developed as in the lands on both sides of the Atlantic.

As a matter of fact the Wisconsin glaciers throughout their various stages were always of limited and regional rather than of truly continental extent. The Islands of the Arctic Archipelago lying north of the ice sheets were never glaciated. Neither was the interior of Alaska.

The center of Wisconsin glaciation moreover moved from Labrador to Keewatin during the epoch. What sort of climatic changes could produce these shifts in the center of ice accumulation? Who can imagine a shift in present climate that would produce a continental glacier on the Arctic Archipelago while allowing that of Greenland to dwindle away? Yet something very like that happened in Wisconsin Time when the glacial center moved westward across Hudson's Bay from Labrador to Keewatin.

The evidence of the timberlines shows, however, that climatic changes of that type are occurring to-day. The climate in Alaska has recently become more favorable for trees and that of the northeastern portion of the continent less favorable. Everything indicates these changes are still going forward. When we come to understand their causes, it may be that we shall be set forward also in an understanding of the causes of ice ages.

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[11] Poul Norlund, "Viking Settlers in Greenland and their Descendents during 500 Years." Cambridge University Press, 1936.

[12] Frére Marie Victorin, Cont. Bot. Lab. University of Montreal, No. 131, p. 77 *seq.*, 1929.

[13] M. L. Fernald, *Rhodora*, 13: 109–62, 1911.

[14] SCIENCE, 93: 509, 1941.

"VEGETABLE DYNAMICKS" AND PLANT TISSUE CULTURES[1]

By Dr. PHILIP R. WHITE

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, PRINCETON, N. J.

Some time ago, at a dinner at the Yale Medical School, I was asked to occupy the chair specially built for the Honorable William Howard Taft when he was professor of jurisprudence at Yale—and was made to feel very, very small thereby. Now you have done me the honor to link my name, however tenuously, with that of the father of our discipline, Stephen Hales. It is hard to know whether to be inflated by the connection or deflated by the comparison. Whatever should be my reaction, I deeply appreciate the honor. In accepting that honor, I shall try not to impose upon your patience after a good meal by talking to you too long.

Stephen Hales's interests, as a minister of the gospel and a humanitarian, led him to touch upon anything which could contribute to the welfare of his fellow men and redound to the glory of Almighty God. The processes by which God's creatures function in their everyday lives could, according to his lights, only show the perfection of the works of the Great Planner. Thus, Hales set to work to discover what details he could in that plan, in a spirit of humility. And, since plants were also God's creatures and Hales was a good gardener as well as a good shepherd, he turned much of his interest to a study of what he chose to call "Vegetable Staticks."

In Hales's day, the classification of plant parts into tissues, proposed by the Greeks, and especially by Theophrastus, had been for the most part forgotten, and his considerations were wherever possible of the plant as a whole. But the philosophical analyses of Theophrastus and the anatomical work of Grew and Malpighi, Hooke and Loewenhoeck had already laid the foundations for another point of view. As our knowledge of the living functions increased, so did the complexity of the plan revealed increase, until it became an almost hopeless task to unravel the details while trying to encompass the whole picture, even as regards a single creature. Thus it happened that, about a century after Hales's epoch-making work, there came to be formulated the so-called cell theory which said, in essence, "It is not necessary to encompass the plan of a plant or animal in its entirety and all at once, for each creature is made up of a sum of many smaller, simpler, potentially autonomous organisms, the cells. Learn to understand the plan of a single cell. From that the greater Plan can be built up." That theory, while sharing the field with the older concept of the organism as a whole, has nevertheless dominated much of our thoughts as cytologists, as anatomists, as geneticists and as physiologists for the past century.

Hales developed a series of techniques for studying the organism as a whole which are still useful. But, as we have passed from the larger aspects to smaller and still smaller ones, the technical difficulties have increased. To deal with single cells, we must have methods adapted to that end. Haberlandt saw that clearly forty years ago and set in train the series of explorations of which I am but one of the momentary advance guard.

We can not yet grow single somatic cells of higher plants, as Haberlandt would have had us do. Some day I am certain some one will be able to do so. But we can grow comparatively simple organs and tissue complexes. A few of you, I know, have followed the steps by which that has been accomplished. Others I am sure have not, and I hope I will be forgiven if I review briefly for their benefit the development of the field. The aim was, as we have said, the study of single somatic cells of higher plants. The method aimed at was the cultivation of those cells, their study as separate entities, and their subsequent aggregation into more and more complex groupings until full-blown organisms could again be attained. Haberlandt tried to grow single green somatic cells, unsuccessfully, as did many of his students. Kotte and Robbins in 1922 compromised by using, not cells, but organs—root tips—with some success. But the results were not sufficiently promising to encourage further work and the attempt was not pushed further. A decade later the problem came to my attention and I decided, on theoretical grounds, to study three types of materials—embryos, seed primordia and root tips. Of these, the last proved most satisfactory. With them a beginning has been made toward a solution of the problems involved.

Fundamental, of course, was the need of an environment that should replace all the essential features of that in which the cell or tissue or organ finds itself in the organism while discarding the non-essentials—as regards physical and chemical composition of that environment. Temperature, light, oxygen tension, acidity, physical state, motion, conditions of contact, as well as ionic composition, content in energy sources, hormonal and vitamin content and similar aspects all had to be studied. And, while many of these requirements were likely to prove similar for all cells, others might not prove similar. We have solved all these problems in a preliminary way. But those solutions are in many cases obviously not yet the most perfect ones possible, and the work still goes on. We are on fairly firm ground as regards the physical conditions, the inorganic nutrition and the carbohydrate supply. Requirements as regards organic nitrogen supply, vitamins and hormones are less clearly established, although conditions which are "satisfactory" are known.

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[1] Abridged from the Stephen Hales Prize Address, given before the American Society of Plant Physiologists, Dallas, Texas, December 29, 1941.

We are, however, now in a position to grow a variety of plant materials, root tips of many species, embryos, undifferentiated tissue masses from *Salix, Nicotiana, Helianthus, Daucus, Ulmus,* and a few other sorts, *in vitro*, for long periods and to control the environments in which they grow with a considerable degree of precision. The technique for which Haberlandt was searching is thus now available and it is, I trust, because of the part I have played in developing that technique, rather than for any particular application, that you have honored me this evening.

It would be superfluous for me to review our findings in detail here. It is my task, rather, to point out the directions in which we have already moved and perhaps to outline briefly some of the new fields in which we may hope to find opportunities for further work.

As I have already noted, problems in nutrition were among the first to present themselves and the way in which they have been solved points to other possibilities in the same direction. How significant is the calcium-magnesium balance in the economy of an isolated tissue? Less so, I think, than we have long been led to believe. What is the value of iron for cells which possess no chlorophyll? Our results show an unusually clean-cut picture of its importance. Iron is not tolerated at an ionic concentration above about 2×10^{-5} (= 2/100,000) M; yet its omission from the nutrient results in an abrupt and complete, but reversible, cessation of growth. That its function is an indispensable one is evident. What that function is we do not yet know, but the tissue culture technique offers us a hope of finding out. How far is the effectiveness of sucrose in the nutrient to be attributed to the energy it supplies, and how far to its function in maintaining an isotonic state? Our studies emphasize its energy-giving function and show that the isosmotic function is relatively unimportant. How does iodine affect the morphogenetic pattern? How does oxygen tension affect this same pattern? And how does sucrose, a classic plasmolytic agent, penetrate to the interior of the cell? When I published experiments showing that excised tomato roots preferred sucrose to dextrose, I let myself in for some criticism from those who followed the text-book story. But I also received a very heartening and interesting letter from Dr. Annie May Hurd-Karrer, saying that in 1926 she had been puzzled by evidence of a similar preference by *Ustilago* infecting corn. Perhaps the question needs to be re-examined. The text-books have sometimes been wrong. How important is auxin in the economy of an excised member? What is the function of thiamin in a growing tissue? What is the relation between pyridoxine and protein synthesis in the plant? These are but a few characteristic nutritional problems that have been or can be attacked by means of a tissue culture technique.

But the value of the method is by no means limited to nutritional problems. We were from the start interested in using it in dealing with a variety of problems in plant pathology. Some of these have led us into unexpected paths. The method by which viruses travel through the host has long been a puzzle to phytopathologists. This is paralleled and perhaps intimately bound up with the methods by which foods move in the plant. And it is also conceivably bound up with the methods by which water may sometimes be moved through the plant when certain external forces are temporarily in abeyance. The picture of water movement as a function of vital activity of plant tissues has long been a puzzling one. Five years ago, I set out to study this picture as exemplified in growing excised roots, where the complicating factors of photosynthesis, evaporation, trunk expansion and contraction under temperature influences, local hydrolysis, etc., could be eliminated. We have not solved the problem as far as demonstrating a detailed mechanism is concerned. But we have been able to establish certain significant facts in an unexpected and striking way, facts which tend to support and enlarge upon Stephen Hales's old concept of water secretion as a vital function of root tissues, bound up with respiratory processes. Those results at the time seemed again to run counter to accepted text-book theories. But they have since found support in work of Rosene, Grossenbacher, Mason and Phyllis, and others. And the picture which Mason and Phyllis draw certainly corresponds rather closely to that of the contractile vacuole in protozoa, which is another little-understood phenomenon.

Recently we have come back to one of the first problems for the solution of which the value of a tissue culture technique was foreseen, that of the etiology of neoplasia. This we have attacked in plants, using tissues affected at a previous time by crown-gall organisms. The method permits us to maintain growing tumor tissues under continuous and detailed observation, to establish by appropriate tests their freedom from contamination, to subject them to controlled environments, and then, at suitable intervals, to return them to appropriate hosts, where they give rise to new tumors. We have already followed by similar means the processes of growth and differentiation in a neoplasm of genetic origin—that arising in the hybrid cross between *Nicotiana glutinosa* and *N. langsdorffii*. The step from there to neoplasia of biologic (parasitic) origin has not proved a difficult one. May we not hope later to proceed a step further, to neoplasia of recognizable and controllable physiological origin?

These are but a few examples to indicate the proven as well as potential scope of the field which the technique of tissue cultures opens to us. Stephen Hales was not thinking in terms of this sort. But these problems are such that their solution, by whatever means, can give us greater insight into the workings of biological entities, cells, tissues, organs, and thereby of the organisms which were Hales's interest. They may well help us to understand some new bits of the universal plan which he sought to elucidate.

OBITUARY

JAMES J. WALSH

DR. JAMES J. WALSH, of New York, died on March 1. Son of Martin J. and Bridget Golden Walsh, he was born at Archbald, Pennsylvania, on April 12, 1865, so that he was in his seventy-seventh year. He obtained the degree of bachelor of arts from Fordham College in 1884, and that of master of arts in 1885, and then entered the Society of Jesus, intending to pursue a career in the Church, but a few years later was released of his vows, when he felt that he was not fitted for the priesthood. The training with the Jesuits made a lasting impression upon him and gave him skill in dialectics. In 1889, Walsh received the degree of doctor of philosophy from Fordham College.

He began the study of medicine at the University of Pennsylvania and required only two years to complete his course, graduating M.D. there in 1895, with his younger brother, Joseph, whose studies of Galen have delighted the readers of the *Annals of Medical History*. During the next three years he studied in Paris, Vienna and Berlin, where he and his brother had a place in Virchow's laboratory. Whilst in Europe, Dr. Walsh began his career as a medical writer, acting as correspondent for several American journals, and when he returned in 1898, he became assistant editor of the *Medical News*. Later he wrote much for the *New York Medical Journal* and the *Journal of the American Medical Association;* he was the medical and scientific editor of the *Independent* and the medical editor of the New York *Herald*.

In 1900 he was appointed an instructor in medicine and an adjunct professor in 1904 at the New York Polyclinic Medical School, where he taught until 1907, when he was made acting dean and professor of neurology at the Medical School of Fordham University. Here he remained until he resigned in 1913. At Fordham he gave regular lectures on the history of medicine, which were amongst the early ones to be established in the United States. He also lectured on physiological psychology, of which subject he was professor at Cathedral College, New York (1907–1938).

Dr. Walsh was the author of many books, and he established the Fordham University Press. Some of his more important works were "Catholic Churchmen in Science," Philadelphia, 1906; "Makers of Modern Medicine," New York, 1907, which was dedicated to his friend, William Osler; "The Thirteenth, the Greatest of Centuries," New York, 1907; "The Popes and Science," New York, 1908; "History of Medicine in New York," 5 volumes, 1919. Dr. Walsh was always a loyal son of the Roman Catholic Church. His paper, "The Popes and the History of Anatomy," appeared in the *Medical Library and Historical Journal*, Vol. 2, 1904, and that on "The Supposed Warfare between Medical Science and Theology," in the *Messenger*, New York, July, 1906. Dr. Walsh was an authority upon the history of the Roman Catholic Church. He was made a Knight Commander of the Papal Order of St. Gregory and also a Knight of Malta and received many honorary degrees. He belonged to numerous societies, was a life member of the New York Historical Society, a fellow of the New York Academy of Medicine and a member of the American Medical Association.

In 1915 Dr. Walsh married Miss Julia Huelat, who, with a son and daughter, survives him.

ARCHIBALD MALLOCH
NEW YORK ACADEMY OF MEDICINE

RECENT DEATHS

DR. RAYMOND LEE DITMARS, curator of reptiles and of mammals of the New York Zoological Park, died on May 12 in his sixty-sixth year.

BRONISLAW K. MALINOWSKI, Bishop Museum visiting professor at Yale University, who had been appointed professor of cultural anthropology at the university, effective on July 1, died on May 16. He was fifty-eight years old.

DR. CLAYTON HALSEY SHARP, from 1914 to 1933 vice-president of the Electrical Testing Laboratories, New York, died on May 15, at the age of seventy-two years.

DR. RUDOLF EMIL HELLMUND, chief engineer of the Westinghouse Electric and Manufacturing Company, with which he had been associated since 1907, died on May 16, at the age of sixty-three years.

DR. GEORGE SELLERS GRAHAM, associate in pathology of the Graduate School of Medicine of the University of Alabama, died on May 2, at the age of sixty-three years.

DR. H. L. BOWMAN, from 1909 to 1941 Waynflete professor of mineralogy and crystallography at the University of Oxford, died on April 22, at the age of sixty-eight years.

DR. WILLIAM JOHN YOUNG, professor of biochemistry at the University of Melbourne, known for his work on alcoholic fermentation, died on May 14. He was sixty-three years old.

LIEUTENANT-COMMANDER L. C. BERNACCHI, physicist to the Southern Cross Antarctic Expedition, 1898, and to the National Antarctic Expedition, led by Captain Scott, R.N., 1901–04, died on April 24, at the age of sixty-six years.

SCIENTIFIC EVENTS

THE GEORGE F. BAKER PAVILION OF THE NEW YORK HOSPITAL

THE private patients' division of the New York Hospital will be named the George F. Baker Pavilion, commemorating the part played by Mr. Baker and his son, George F. Baker, Jr., in the development of the institution.

The pavilion, having six floors and more than 100 rooms for patients, comprises, with the medical and surgical floors, the central unit of the New York Hospital-Cornell University Medical College center, 68th Street and York Avenue. Formerly known only as a part of the general hospital, the George F. Baker Pavilion now becomes one of the six separate services conducted by the Society of the New York Hospital, which include the New York Hospital, the Lying-In Hospital, the Children's Clinic, the Payne Whitney Psychiatric Clinic and the New York Hospital-Westchester Division.

In connection with this pavilion, the Board of Governors also voted to open the entrance for private patients, and to place an inscription thereon to read "The George F. Baker Pavilion." The dedication of the pavilion will take place on September 1, the tenth anniversary of the opening of the present hospital buildings.

Mr. Baker senior was a governor of the hospital from 1899 to 1931, and his son from 1931 until his death in 1937. Their combined service thus covered a period of approximately forty years, which was probably the most eventful and progressive in the one hundred seventy-year history of the New York Hospital. The advances made during this period, culminating in the opening of the present center in 1932, were due in large part to the vision and leadership of the father and son, as well as to their generous financial support.

Their gifts to the institution were made over a period of many years, and included a grant made by the older Mr. Baker in 1912 to bring about the hospital's teaching affiliation with Cornell University Medical College, and donations by both father and son in 1927 toward the incorporation of the Lying-In Hospital in the new medical center.

DEDICATION OF THE TECHNOLOGICAL INSTITUTE OF NORTHWESTERN UNIVERSITY

NORTHWESTERN UNIVERSITY will dedicate on June 15 and 16 its new Technological Institute, built at a cost of $6,735,000.

The engineering and science laboratories, which have just been completed, already are engaged in extensive research and training for the government's war effort. This essential work will continue uninterrupted during the dedication. The place of engineering during the war and afterwards will be the subject of the dedicatory ceremonies.

Among the facilities in the new building are an artificial river for testing ship models and wave action; a 1,500,000-volt surge generator; cold rooms for research at extremely low temperatures; a 1,000,000-pound transverse-universal testing machine two and a half stories high; the quietest room in the world; an explosion-proof room for the study of gases under high pressure; and a 5,000,000-pound hydraulic testing machine. More than $1,000,000 worth of equipment is already in use for teaching and research. Adequate room for expansion has been allowed in all departments.

The building dominates the aerial view of Chicago's North Shore. More than 500 feet long and 347 feet deep, it has a floor area of 423,000 square feet—which makes it larger than all the other academic buildings on the Evanston campus combined, and one of the largest educational buildings in the country. It looks like two letter E's laid back to back and joined by a central structure. There are six wings, each of which is occupied by one of the six departments, physics and chemistry of the College of Liberal Arts, and civil, mechanical, electrical and chemical engineering.

Established through a gift from Walter P. Murphy, inventor and manufacturer of railroad supplies, the institute was opened in 1939 and moved into its new building last fall. When it is fully under way it will have an enrolment of 900 men, all pursuing a five-year cooperative course which calls for alternating a three-month period of study in the classroom with an equal period of work in industry. This plan is designed to train the student in practical as well as theoretical engineering; to assist industry in training its future executives, and to assist boys with limited means to gain technical education.

Students are now employed in the plants of seventy cooperating firms in various parts of the country. They are placed in jobs related to their chosen field of engineering and remain with the same firm throughout their course, after which they are engaged as full-time employees and have the benefit of their experience. Wherever possible the job is with a firm in the student's home town, so that he may live at home. Students are paired to replace each other each quarter, so that the job in industry is always filled.

At the dedication ceremonies, the principal addresses will be made by Donald Nelson, head of the War Production Board; Charles F. Kettering, president of the General Motors Research Corporation; Lieutenant General William Knudsen, member of the advisory War Production Board; and Jesse Jones, U. S. Secretary of Commerce. More than 800 representatives of industry, railroads, educational institutions and business will attend. Two hundred sixty-three industrial and business leaders are members of the honorary advisory committee for the event.

NATIONAL RESEARCH COUNCIL FELLOWSHIPS IN THE NATURAL SCIENCES

THE National Research Fellowship Board in the Natural Sciences of the National Research Council has made the following fellowship appointments for the academic year 1942–1943:

Harry Gregory Albaum (Ph.D., biology, Columbia University, 1938). To work at the University of Wisconsin on the relation between metabolism and growth in higher plants.

Thomas Hunter Allen (Ph.D., zoology, State University of Iowa, 1941). To work at the University of Chicago on "Does activation involve splitting of protyrosinase?"

Elizabeth Jean Armstrong (Ph.D., geology, Bryn Mawr College, 1939). To work at Columbia University on the conditions governing the formation of quartz crystals.

Elkan Rogers Blout (Ph.D., chemistry, Columbia University, 1942). To work at Harvard University on the structure of Yohimbine.

Robert Thornton Brumfield (Ph.D., botany, Yale University, 1942). To work at Harvard University on cell-lineage studies in plant organs by means of x-ray-induced chromosome rearrangements.

Victor Alexander Drill (Ph.D., physiology, Princeton University, 1941). To work at Northwestern University on the specificity of liver function tests in the detection of hepatic damage produced by various experimental procedures and the relation of the damage to the Kupfer cells.

Harry Emmett Gunning (Ph.D., physical chemistry, University of Toronto, 1942). To work at Harvard University on the conductance of dilute solutions of electrolytes.

Daniel Lambert Harris (Ph.D., zoology, University of Pennsylvania, 1942). To work at the University of California on a physical and chemical analysis of the structural elements of protoplasm.

Julius David Heldman (Ph.D., physical chemistry, Stanford University, 1942). To work at the University of California on kinetic and equilibrium studies of the homogeneous catalytic isomerization of paraffin hydrocarbons.

William Albert Hiltner (Ph.D., astronomy, University of Michigan, 1942). To work at the McDonald Observatory of the University of Texas on a photometric atlas of typical stellar spectra.

Byron Robinson Houston (Ph.D., plant pathology, University of California, 1939). To work at the University of Wisconsin on a physiologic comparison of strains of *Corticium solani*. The correlation of morphology, nutritional requirements and pathogenicity with special reference to the basidial stage.

Hugh McKinney Hulburt (Ph.D., physical chemistry, University of Wisconsin, 1942). To work at Princeton University on the kinetics of chemical reactions in flow systems.

Nathan Kornblum (Ph.D., organic chemistry, University of Illinois, 1940). To work at Harvard University on a stereochemical study of the forces existing between electrostatically charged groups in the same molecule.

Howard Levi (Ph.D., mathematics, Columbia University, 1942). To work at the Institute for Advanced Study on ideals of differential polynomials.

Joseph Carl Robnett Licklider (Ph.D., psychology, University of Rochester, 1942). To work at Harvard University on the effects of previous acoustic stimulation upon sound localization.

Charles Duncan Michener (Ph.D., entomology, University of California, 1941). To work at Harvard University and the Massachusetts State College on the comparative morphology and evolution of the abdominal appendages of insects.

Foil Allan Miller (Ph.D., chemistry, the Johns Hopkins University, 1941). To work at the University of Minnesota on the Raman and infrared spectra of some compounds of biological importance.

Francis Eugene Randall (Ph.D., biology, Harvard University, 1942). To work at the Western Reserve University on the relationships of the bony and fleshy noses in man and their reconstruction possibilities.

Herschel Roman (Ph.D., genetics, University of Missouri, 1942). To work at the California Institute of Technology on (1) problems of gene action; (2) the location of genes in the physical chromosome.

Arnold Hicks Sparrow (Ph.D., cytology, McGill University, 1941). To work at Harvard University on an investigation of chromosome mechanics with the aid of colchicine and x-ray-induced changes.

Luther Irwin Wade, Jr. (Ph.D., mathematics, Duke University, 1941). To work at the Institute for Advanced Study on a study of arithmetic properties of polynomials in a Galois field and related functions.

Harold Francis Weaver (Ph.D., astronomy, University of California, 1942). To work at the Yerkes Observatory on stars in galactic clusters showing anomalous K-line intensities.

Alvin Martin Weinberg (Ph.D., mathematical biophysics, University of Chicago, 1939). To work at Columbia University on the physico-mathematical aspects of nerve structure and function.

Alma Joslyn Whiffen (Ph.D., botany, University of North Carolina, 1941). To work at Harvard University on the nutrition and life histories of the Chytridiales.

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT the annual meeting of the American Academy of Arts and Sciences, held at its house, 28 Newbury Street, Boston, on May 13, one new foreign honorary member, Lorenzo R. Parodi, of Buenos Aires, and twenty-one new fellows were elected.

Those elected in the natural and exact sciences were:

Mathematical and Physical Sciences: Wilmer Lanier Barrow, the Massachusetts Institute of Technology; Francis Birch, Harvard University; Samuel Cornette Collins, the Massachusetts Institute of Technology; Otto Struve, director, Yerkes Observatory.

Natural and Physiological Sciences: William Irving Clark, Worcester; Russell Gibson, Harvard University; Samuel Albert Levine, Harvard Medical School; William Ralph Maxon, U. S. National Museum; Hermann Joseph Muller, Amherst College.

The officers elected for 1942–1943 were:

President, Harlow Shapley; *Vice-president* for Class I, Percy W. Bridgman; *Vice-president* for Class II, S. Burt Wolbach; *Vice-president* for Class III, Sidney B. Fay; *Vice-president* for Class IV, Fred N. Robinson; *Corresponding Secretary,* Abbott P. Usher; *Recording Secretary,* Hudson Hoagland; *Treasurer,* Horace S. Ford; *Librarian,* Frederick H. Pratt; *Editor,* Robert P. Blake.

The meeting was addressed by Dr. Mark Graubard, who spoke on "Morale for a Democratic Offensive."

THE AMERICAN PHILOSOPHICAL SOCIETY

AT the annual general meeting of the American Philosophical Society held in the hall of the society in Philadelphia on April 23, 24 and 25, Dr. Edwin G. Conklin, of Princeton University, was elected president, and Dr. Frederick P. Keppel, president, retired, of the Carnegie Corporation, was elected a vice-president. Leicester B. Holland, Class IV, was elected a councilor to fill the unexpired term on the council of F. P. Keppel. *Members elected to the council* to serve for three years: Class I, C. E. Kenneth Mees; Class II, Douglas Johnson; Class III, Roland S. Morris; Class IV, Campbell Bonner.

Officers reelected were: *Vice-presidents,* William E. Lingelbach and Frank Aydelotte; *Secretaries,* W. F. G. Swann and Benjamin D. Meritt; *Curator,* Albert P. Brubaker; *Treasurer,* Fidelity-Philadelphia Trust Company.

Thirty resident members were elected. Those in the natural and exact sciences were:

Mathematical and Physical Sciences: Oliver Ellsworth Buckley, New York, N. Y.; Leo Alvin DuBridge, Rochester, N. Y.; Duncan Arthur MacInnes, New York, N. Y.; Robert Raynolds McMath, Pontiac, Mich.; Francis Dominic Murnaghan, Baltimore, Md.; Harald Malcolm Westergaard, Cambridge, Mass.; Robert Runnels Williams, Summit, N. J.

Geological and Biological Sciences: Leonard Carmichael, Medford, Mass.; Theodosius Dobzhansky, New York, N. Y.; Edward Adelbert Doisy, St. Louis, Mo.; Carl Owen Dunbar, New Haven, Conn.; Louis Otto Kunkel, Princeton, N. J.; Thomas Milton Rivers, New York, N. Y.; Lewis Hill Weed, Baltimore, Md.

Eight foreign members were elected as follows:

Harold Spencer Jones, Greenwich, England; Hendrik Anthony Kramers, Leiden, Netherlands; Ivan Matveitch Vinogradov, Moscow, U.S.S.R.; Octavio Méndez-Pereira, Panama City, Panama; Richard Henry Tawney, London, England; Paul van Zeeland, Brussels, Belgium; Amado Alonso, Buenos Aires, Argentina; William A. Craigie, Oxford, England.

SCIENTIFIC NOTES AND NEWS

THOSE receiving honorary degrees at the hundred and seventy-sixth anniversary of Rutgers College include Dr. Vannevar Bush, president of the Carnegie Institution of Washington, and Dr. Thomas Parran, Jr., surgeon general of the U. S. Public Health Service.

THE doctorate of science was conferred on May 19 at the commencement exercises of Brown University on Dr. Arthur F. Buddington, of the Class of 1942, professor of geology at Princeton University.

The Arthur Hoyt Scott Garden and Horticultural Award of a gold medal and cash prize of $1,000, which was awarded to Dr. C. Stuart Gager, director of the Brooklyn Botanic Garden, in 1941, will be presented to him on the occasion of the opening, on May 23, of a new open-air theater at Swarthmore College. Dr. Gager will make the dedication address, speaking on "Theaters, Gardens, and Horticulture." The 1942 award will be presented to Richardson Wright, editor of *House and Garden*, chairman of the board of the Horticultural Society of New York and chairman of the International Flower Show.

Dr. Joseph A. Becker, research physicist of the Bell Telephone Laboratories, was presented on May 3 with the Mendel Medal of Villanova College, in recognition of his contributions to the thermal emission of electrons and to the behavior of electrons at rectifying junctions.

At the annual meeting in Cincinnati on April 15 of the American Association of Industrial Physicians and Surgeons, the W. S. Knudsen Award was presented to Dr. Clarence D. Selby, Detroit, since 1935 medical consultant to the General Motors Corporation, for "the most outstanding contribution to industrial medicine."

Dr. W. V. Cruess, head of the fruit products laboratory of the College of Agriculture of the University of California, has been awarded the first Nicholas Appert Medal of the Institute of Food Technologists. It will be presented to him on June 16 at the annual convention of the institute in Minneapolis. The medal will be awarded annually for "outstanding contributions to the development of improved food preservation methods."

The Melchett Medal of the British Institute of Fuels for 1942 has been awarded to Dr. Arno Carl Fieldner, head of the technological branch of the U. S. Bureau of Mines in Washington.

The Jacksonian Prize for the year 1941 of the Royal College of Surgeons, London, has been awarded to W. Bremner Highet, of the Wingfield Morris Orthopaedic Hospital, for his essay on "Injuries to Peripheral Nerves, with Especial Reference to the Late After Results." The John Tomes Prize for the years 1939–41 has been awarded to R. V. Bradlaw, for his work on the microscopical structure of the dental tissue.

The James Alfred Ewing Medal for 1941 has been awarded to Dr. F. W. Lanchester, consulting engineer and technical adviser to various corporations, on the joint recommendation of the presidents of the Royal Society and the British Institution of Civil Engineers. The medal is awarded annually for research work in the science of engineering.

Nature reports that the following awards for the year 1941 were made on March 27, at the annual corporate meeting of the Institution of Chemical Engineers: The Osborne Reynolds Medal, for meritorious work accomplished for the advancement of the institution during the year, to Dr. A. Parker, honorary editor and recorder of the institution; the Moulton Medal (in gold), for the best chemical engineering paper of the year, read before the institution and published in the *Transactions*, to P. Parrish, for his paper, "Modern Developments in the Design of Plant for the Concentration of Sulphuric Acid"—the Junior Moulton Medal for 1941 was not awarded; the William Macnab Medal, for the best set of answers submitted in the associate-membership examination during the year, to E. W. Pates.

Dr. Esmond R. Long, professor of pathology at the University of Pennsylvania and director of the laboratories of the Henry Phipps Institute, president of the Association for the History of Medicine; and Dr. Henry E. Sigerist, director of the Institute of the History of Medicine at the Johns Hopkins University, have been elected honorary members of the Society for the History of Medicine at Buenos Aires.

Dr. Roy C. Newton, vice-president in charge of the Research Laboratories of Swift and Company, has been elected chairman of the Chicago Section of the American Chemical Society.

Dr. William T. Caldwell, chairman of the department of chemistry of Temple University, has been named dean of the College of Liberal Arts.

At Columbia University, Dr. W. Duncan Strong has been promoted to a professorship of anthropology and Dr. Arthur W. Pollister to an associate professorship of zoology. Dr. Fred S. Keller has been named assistant professor of psychology and Dr. Jerome M. B. Kellogg, assistant professor of physics.

Dr. Jacques P. Gray, a unit director of the Michigan Community Health project of the W. K. Kellogg Foundation, has been appointed, effective on July 1, professor of preventive and public health medicine and dean of the Medical College of Virginia at Richmond. Dr. Lee E. Sutton, Jr., who has been dean for the past ten years, will continue as professor of pediatrics.

Dr. W. Vann Parker, since 1936 a member of the department of mathematics at the Louisiana State University, will succeed in the autumn as head of the department Professor S. T. Sanders, who has been a member of the faculty for forty years, and will retire, having reached the age limit of seventy years.

DR. CARL O. DUNBAR, professor of paleontology and stratigraphy at Yale University and curator of invertebrate paleontology at the Peabody Museum, has been named director of the museum. He will succeed Albert E. Parr, who has been appointed director of the American Museum of Natural History, New York. Daniel Merriman has been promoted from instructor to assistant professor of biology and will become curator of the Bingham Oceanographic Collection, a position which Mr. Parr also held.

DR. WILLIAM H. HOBBS, professor emeritus of geology at the University of Michigan, has been appointed a consultant of Far Eastern Affairs for the Office of the Coordinator of Information, Washington, D. C. The appointment is a result of his knowledge of the Japanese mandated islands of the Pacific. When carrying on geological research work in the West Pacific, Dr. Hobbs, on his trip in 1921, visited and made studies of Bonin, the Sulphurs, the Carolines, the Pelews, Yap and other Japanese mandated islands as well as Japan, North Borneo, the Macassar Straits, Java, Sumatra and Rangoon.

DR. CHARLES E. REED, assistant professor of chemical engineering at the Massachusetts Institute of Technology, has joined the staff of the Research Laboratory of the General Electric Company at Schenectady, N. Y., as consulting chemical engineer.

DR. CHARLES GALTON DARWIN, director of the National Physical Laboratory, has been named scientific adviser to the British Army Council.

PROFESSOR JAMES A. SCOTT WATSON has been appointed by the British Government to the posts of agricultural attaché on the staff of the British Ambassador to the United States and agricultural adviser to the High Commissioner for the United Kingdom in Canada. These offices have been established to secure the closest possible contacts on current and future agricultural problems of Great Britain, the United States and Canada.

A CORRESPONDENT writes: "Most unfortunately, the press and radio mentioned several times in mid-April a rumor that Dr. Carrel was being considered for a place on the Laval cabinet as Minister of Health. It is particularly regrettable that no correction was made in the press when the final cabinet was announced, and another man, Dr. Grasset, was named Minister of Health. At considerable personal sacrifice, Dr. Carrel has remained in France to do what he can to help the people in their extremity. His friends are greatly distressed at the linking of his name with the Laval government."

DR. FRANCIS PERRIN, professor of theoretical physics at the Sorbonne, Paris, now visiting professor at Columbia University, gave on May 8 the John Howard Appleton Lecture at Brown University, in conjunction with the Rhode Island Section of the American Chemical Society. He spoke on "Nuclear Energy."

UNDER an exchange lecture arrangement between the Michigan College of Mining and Technology and the University of Michigan, Professor A. K. Snelgrove, of Michigan College, head of the department of geological engineering and member of the Committee on Mining Geology of the American Institute of Mining and Metallurgical Engineers, delivered recently at Ann Arbor a series of addresses on "Geological Prospecting Criteria." Associate Professor A. J. Eardley, of the University of Michigan, discussed oil geology, Cordilleran structures and tactical and geological interpretation of aerial photographs in his lectures at Houghton.

THE usual courses in spectroscopy will not be given at the Massachusetts Institute of Technology this summer.

THE third annual meeting of the Southeastern Section of the Botanical Society of America will be held on June 12, 13 and 14 at Knoxville, Tenn., with the University of Tennessee as the host institution. The program will include trips to the TVA laboratories and tree crop nursery at Norris, the Agricultural Experiment Station of the University of Tennessee and the Great Smoky Mountains National Park. A discussion of the vegetation of the Great Smoky Mountains will be led by Dr. S. A. Cain and Dr. A. J. Sharp, of the department of botany. Dr. Cain will discuss "The Tertiary Nature of Southern Appalachian Forests," and Dr. Sharp will speak on "Highlights of the Southern Appalachian Flora." Dr. W. H. Camp, of the New York Botanical Garden, will lecture by invitation on "The Origin and Genetic Structure of Species."

THE Association for the Study of Internal Secretions announces the establishment of the Ciba Award to recognize the accomplishment of an investigator not more than thirty-five years of age in the field of endocrinology. Work cited may be either in the field of preclinical or clinical endocrinology. The award is for $1,200. If the recipient should choose to use the award toward further study in a laboratory other than that in which he is at present working, it will be increased to $1,800. The option is left entirely to the recipient. Choice of the recipient is in the hands of the committee of awards of the association, composed of five members.

THE Office of Psychological Personnel has been established by the American Psychological Association under the auspices of the Division of Anthropology and Psychology of the National Research Council, to be concerned with the maximum, effective utilization of psychologists in the war effort. This office is continuing and extending the work begun last year by the Subcommittee on the Listing of Personnel in Psychology, of which Dr. Steuart Henderson Britt is chairman. Dr. Britt is now serving as executive director of the Office of Psychological Personnel and may be addressed at the National Research Council, 2101 Constitution Avenue, Washington, D. C.

A NATIONAL Registry of Rare Chemicals has been established by the Armour Research Foundation. Information on chemicals too rare to be listed in the catalogues of regular chemical supply houses will be filed with the registry and indexed according to name, location and amount available. Dr. Martin H. Heeren, chairman of chemical engineering research, has been appointed director. Chemicals to be found in the catalogues of supply houses are not included, but all those not available through regular channels will be listed. The file will be regarded as confidential and will not be open to general inspection. Specific inquiries will be answered by the registry. In transactions in which the owner of the chemical wishes to remain anonymous to prevent the disclosure of commercial secrets, the registry will act as intermediary.

DISCUSSION

GRAVEL OUTWASH NEAR CHILLICOTHE, OHIO

THE occurrence of Illinoian gravel at two markedly distinct levels on the border of the Scioto Valley, near Chillicothe, Ohio, though known for many years, seems not to have been given a satisfactory interpretation. There are quite extensive deposits of the gravel directly east of Chillicothe at an altitude of 800 to 860 feet, or 200 to 250 feet above the flood plain of the Scioto River. Directly south of these deposits on ground only 700 to 740 feet there is a sheet of glacial gravel showing a similar degree of weathering. They both are regarded as an Illinoian outwash by the several geologists who have observed them. They were noted by M. R. Campbell in 1918 in a description of the country around Camp Sherman printed on the back of the Camp Sherman map, and the suggestion made that two lobes of the Illinoian ice sheet, one occupying the Scioto Valley and the other Walnut Creek, met and enclosed between them the ground carrying the high gravel deposits. The lobes then became separated and exposed the ground to the south where the lower deposits are located. This interpretation was cited by J. E. Hyde in his report on the Camp Sherman Quadrangle.[1] But he decided that it was not to be accounted for by such localized conditions, as the deposit extends far up Walnut Creek. He noted that the upper limits of these gravels are nearly identical with Illinoian gravels on Paint Creek and its tributaries west of the Scioto Valley, and likely to have been determined by wide-spread common condition. He also found the lower set of gravels to have a distribution far down the Scioto Valley. But he failed to find a satisfactory explanation of the occurrence of the two sets of deposits at such markedly different levels.

The Cincinnati ice blockade of the Ohio River in the Illinoian stage of glaciation has been pretty fully established in the geological literature for more than fifty years. The ponding that it is assumed to have produced above the site of the ice dam has also been under discussion from the first. In 1890 the Beech Flats of northwestern Pike County, only 25 to 30 miles southwest from Chillicothe, were found by G. F. Wright to carry silt deposits at a level similar to the highest gravel deposits under discussion, and were interpreted by him to be due to the ponding by the Cincinnati ice dam.[2] It therefore seems natural to look to this ice blockade of the Ohio for the explanation of the features under consideration. It seems very probable that we have in the higher set of gravel deposits a close relation to the giving way of the ice dam. That they fill a space of fully 50 feet in altitude, and are of gravel with some interbedding of silt, seems a natural condition attending the breaking of the blockade, with some fluctuation in the height of the ponding. An interval of some years may have been involved in the complete clearing of the blockade. The lower set of deposits in the Scioto Valley probably dates from the practical disappearance of the obstruction of the Ohio River in the vicinity of Cincinnati. The distribution of the gravel far down the Scioto shows a free drainage, inconsistent with the presence of an obstruction in the Ohio valley. It is a matter of especial interest that we seem to have in these two sets of deposits decisive evidence that the Illinoian ice held possession of the Scioto Valley as far down as Chillicothe after the blockade of the Ohio had been lifted.

A few words seem pertinent as to the pre-Illinoian trenching of the Scioto Valley. Well records presented by Professor Hyde in his report on the Camp Sherman area show the bedrock in Chillicothe and points above that city to have been trenched to a level fully 100 feet below the present stream, or to less than 500 feet above sea level. The filling with gravel to 700 feet thus shows an aggradation of about 200 feet.

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[1] *Bull.* 23, Geol. Survey of Ohio.

[2] *Bull.* 58, U. S. Geol. Survey, pp. 92–96. 1890.

FRANK LEVERETT

ANN ARBOR, MICH.

AVERAGE HEIGHT OF AMERICAN MEN

RECENT articles in SCIENCE have left the reader with a certain amount of skepticism as well as a large amount of thought-provoking data.

In the December 12 issue of SCIENCE (Vol. 94, No. 2450, pp. 552–553) Leonard R. Rowntree gives an average height of over 2,000,000 registrants examined as 67½ inches, the identical average of men in World War I. An increase in weight of 8 pounds was shown.

In the January 13 issue of SCIENCE (Vol. 95, No. 2454, *Supplement*, p. 13) Dr. Laurence B. Chenoweth and Richard G. Canning found that of 10,005 students of the University of Cincinnati born between 1904 and 1921, the average height of freshmen in 1916 was 67.5 inches; in 1936 it had increased to 69.9 inches; and that no increase in average size had occurred since 1936. Not only has the size of man increased, the scientists say, but children are growing more rapidly.

To this reader the foregoing statements are very contradictory unless the increased weight of registrants as shown by Rowntree can be assumed to be increased size. Even with this assumption, the conclusions drawn by Chenoweth and Canning that the size of man has increased and children are growing more rapidly is only half substantiated by Rowntree's observations.

Not having available the full text of either report it may be premature on my part to comment; nevertheless, outwardly there appears to be a false hypothesis on the part of Chenoweth and Canning, not on the data obtained, but as a result of the population from which their sample was drawn. Since their sample was only representative of those individuals who no doubt had, through the force of circumstances, been given greater or higher privileges as children, as evidenced by their university attendance, it should not have been used to draw the general conclusions given. In Rowntree's sample of 2,000,000 individuals, taken from all walks of life and from all sections of the United States, it would seem that we have a most complete and uniform distribution, and the odds that the average is a true average are very great. He shows no growth in height from 1916 to 1941, but does show an increase in weight.

These observations would lead one to conclude that the childhood care and advantages, which result in increased growth, are much greater for those students in the University of Cincinnati than for the United States as a whole, and that any conclusions drawn by Chenoweth and Canning should be confined and not generalized.

The most interesting and enlightening article, "Life in the Andes and Chronic Mountain Sickness," by Dr. Carlos Monge, University of San Marcos, Lima, Peru (SCIENCE, Vol. 95, No. 2456, pp. 79–84) would appear to be of value to our officers of the Army, Navy and Air Corps. The strength, lung and heart reactions of the Andean man is certainly something to be reckoned with. It indicates there is possibly a selective area in the United States from which men for certain types of combat and for combat in certain types of terrain could or should be drawn. We have in this country men coming from sea-level to elevations of several thousand feet. Very few have probably been reared at elevations above 6,000 to 7,000 feet, but many have been reared in elevations of 2,000 to 5,000 feet, and their heart, lung and strength reactions would possibly be in a more or less direct ratio to the elevation in which they were reared.

Have our commanding officers given any thought to grouping these men according to their branches of service and to the possible combat areas in which they are to serve? Would not a grouping of our men from coastal areas or sea-level and from the areas of higher altitudes give greater efficiency to our armies?

After reading the latter article by Dr. Monge it was recalled that Rowntree showed that 7 of 10 men from Colorado were accepted as physically fit for service, but only 3 of 10 from one of the southern states. The elevation of Colorado may or may not be a factor, but it does give food for thought to the layman.

In conclusion, I should like to see Dr. Monge's article stripped of its more technical terms, written in a more popular vein so that the layman could better understand it fully and published for distribution. It is believed that many people would derive as much pleasure and information from reading it as I have.

S. L. CALHOUN

LELAND, MISSISSIPPI

A CASE OF "WINE-FED" TERMITES

DURING the summer of 1937, a wine dealer was alarmed at the leaking of wine from wooden boxes packed on the floor of his concrete vault. On examination of the cases, insects were found and immediately an exterminator was called in to investigate the situation. The exterminator brought a leaking case of the imported wine to the writer, who identified the "bootleggers" as *Reticulitermes flavipes* Kollar. Several of the bottles had the lead foil, sealing the neck and cork, eaten through, as well as the corks punctured. There were no insects drowned in the wine, but the straw jackets covering the bottles were alive with soldiers and workers both young and old. Two wine-soaked jackets along with several hundred specimens were sealed in a rectangular museum jar. The jar was placed in the dark and periodically examined. When brought into the light the specimens began to coat the jar, so that, after a time the four sides were coated with a clay-like substance. It was a lively, interesting sight to see the specimens running through the tunnels made in the material coating the glass. Over a period of four years, there were no swarms, although many young specimens were observed. No mold was formed, as is often the case when cultivating termites in the laboratory. The end came when the food was consumed.

JAMES A. MULLEN

FORDHAM UNIVERSITY

SCIENTIFIC INTUITION OF A ROMAN EPICURE. A QUOTATION

THE appended quotation[1] from Petronius, Rabelais' prototype at Nero's court, is peculiarly timely to-day:

"But tell us," said Trimalchio, "what was the bill of fare?"

"All right," he replied, "I'll tell you if I can: my memory is so brilliant that I often forget my own name. However, to begin with, we had a roast pig crowned with a wine-cup; this was set off by cheese-cakes and forcemeat done to a nicety; then of course beetroot *and pure whole-meal bread, which I prefer to white bread as being more feeding and better for my liver.*"

W. A. PERLZWEIG

DUKE UNIVERSITY SCHOOL
OF MEDICINE

QUOTATIONS

DISEASE IN WARTIME[1]

MALARIA

BECAUSE it includes one of the recently acquired military bases of the United States, Trinidad takes on new importance to this country. At the request of the Army and Navy and on the invitation of the Government of Trinidad, the Rockefeller Foundation is participating in a study of malaria in the civilian population of that island. Malaria is the outstanding health problem there, and while the identity of the principal vectors responsible for the disease in Trinidad has not been definitely established, evidence points to two species of anopheline mosquitoes. One of these species breeds in the water which collects in the leaves of a plant growing on trees. Malaria is thus often prevalent in regions where the usual marshes and streams, commonly associated with the disease, are absent, and this probably accounts for the fact that malaria is found at nearly all altitudes in Trinidad. The Foundation has assigned a malariologist and an entomologist to determine the factors of the problem, and when these have been obtained it will be possible to make intelligent plans for controlling the disease.

Another project in malaria under Foundation auspices is on the Burma Road. This project was begun in 1940 under the direction of Dr. W. C. Sweet of the Foundation staff. On one section of the Road, troops and truck drivers became heavily infected with malaria a short time after their arrival, and investigations were begun at that point. More than twenty species of anopheline mosquitoes were found in this area, but only one proved to be an effective carrier of the disease. A laboratory has been established directly on the Road, and although under the war circumstances the project has encountered great difficulties, it is hoped that effective control measures will soon reduce the incidence of malaria at this critical section of the highway.

TYPHUS

"In its tragic relationship to mankind," said Hans Zinsser, "the disease of typhus is second to none—not even to plague or to cholera." In most major wars of the past more persons have succumbed to typhus than have fallen on the battlefield—and Zinsser speaks of "the relative unimportance of generals." Whether a similar disaster will accompany this war we do not know, but typhus is now active in many parts of Europe. Epidemics are building up in southern Spain. Other known focuses of the disease are in Poland, Rumania and the neighboring countries, whence it may be expected to spread in disastrous epidemics as the result of conditions imposed by prolonged warfare.

In spite of the fact that it is an age-old problem, our basic knowledge regarding this disease is far from adequate. We know in a general way that it is spread from person to person by means of the body louse and that it develops rapidly with devastating results when people are crowded together under unsanitary conditions and when there is a heavy louse infestation. We also know that in most instances one attack confers lifelong immunity, and we have certain rudimentary knowledge regarding the prevention of its spread by such measures as general delousing and quarantine. But we do not know how best to control or eradicate louse breeding under war conditions. Nor has there been found any highly effective or reliable method of immunization against typhus. Moreover, no specific treatment for the disease, once it is contracted, has thus far been discovered.

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[1] From the Review for 1941 of the Rockefeller Foundation by President Raymond B. Fosdick.

[1] Chapter LXVI, "Petronius: The Satyricon." Translated by J. M. Mitchell. London: J. M. Rutledge and Sons, Ltd.; New York: E. P. Dutton and Company, 1923.

The chief reason that so little progress has been made in the study of this malady is the lack of an experimental animal which would equal man in its susceptibility to typhus, and in which the disease could be reproduced as it occurs in human beings. Until such an animal is found, progress in the study of typhus is bound to be slow. In the past the standard animal employed for this purpose has been the guinea pig, but in comparison with man the susceptibility of the guinea pig to typhus is slight. The infection in this animal is usually characterized by a short transitory period of fever followed by recovery. There has been a tendency to believe that the various preventive measures effective in the comparatively refractory guinea pig are equally effective in the highly susceptible human being. The hazards of such reasoning were recently demonstrated when vaccines which fully protected guinea pigs failed to afford similar protection to laboratory workers exposed to infection due to accident. Two doctors on the staff of the Rockefeller Foundation contracted typhus this last year, although they had been vaccinated with the latest and supposedly the most effective type of vaccine.

The International Health Division of the Rockefeller Foundation began laboratory research in typhus in January, 1941, and soon afterward a field worker was sent to Spain to study on the ground the epidemic active in that country. Some progress was made during the year in finding a better tool for typhus research in the form of a more susceptible animal. This proved to be the Eastern cotton rat, previously used in the United States in the investigation of infantile paralysis. These rats are highly susceptible to European typhus, but only when very young. During the period when they are expected to develop immunity as a result of vaccination, they also acquire a certain degree of natural resistance by simply growing up. On the other hand, they have proved extremely valuable in facilitating comparison of different vaccines as well as in the study of chemotherapy in typhus.

Although the cotton rat is greatly superior to the guinea pig for typhus studies, the search for a still better experimental animal is being continued. Ever since 1938 field workers of the Foundation's International Health Division have been collecting and testing wild animals for their susceptibility to virus diseases, particularly in the jungles of Brazil and Colombia, on the island of Jamaica and in Africa. The previous discovery of the value of the ferret in influenza and the hedgehog in yellow fever suggested that other animals might be discovered if a systematic search were made. It is to be hoped that some animal more susceptible than the cotton rat will soon be found so that advance in knowledge of typhus can be hastened.

INFLUENZA

A year ago in this Review a report was made of the development of a vaccine for influenza A and of the field studies then in progress, both in this country and in England, to determine its efficacy. These studies indicated that while the vaccine effected about a 50 per cent. reduction in the incidence of influenza A, it would have to be greatly improved in quality before it could really control the disease.

During 1941 the research was energetically pushed in relation not only to influenza A but to influenza B; and the laboratories of the Foundation were successful in developing a new technique for measuring antibodies in the blood before and after vaccination. Aided by this technique, eleven different types of vaccines have been prepared and tested in human volunteers in groups varying in size from 150 to 200 persons. Generally speaking, the number of antibodies in the blood of persons vaccinated with some of these types was about the same as that which would follow an actual attack of influenza.

On the basis of these results it was decided to make a field trial of one of the most promising vaccines containing both influenza A and B viruses. Groups of 1,000 persons have therefore been vaccinated in Oklahoma, Georgia, Virginia, Ohio and New York. All vaccinations have been done in large institutions where a similar number of persons living under identical conditions have been left unvaccinated, to serve as controls. At the moment no influenza has been reported anywhere in the United States. If this should be an "off year" for influenza, there may not be an opportunity this winter to test the efficacy of the new type of vaccine.

SCIENTIFIC BOOKS

THE LAPLACE TRANSFORM

The Laplace Transform. By DAVID VERNON WIDDER. x + 406 pp. Princeton: Princeton University Press. 1941. $6.00.

THE Laplace transform has been extensively investigated by two classes of people—mathematicians and applied mathematicians. The latter have been chiefly interested in the formal properties of the

Laplace transform, which make it useful for obtaining solutions of physical problems; the former have been interested in embedding the formal properties in a mathematically satisfying logical structure. This book was written by a mathematician for other mathematicians, and contains no applications outside pure mathematics. However, it could serve as a useful source in which applied mathematicians might look for the properties which they need to use. The first chapter, which is the most convenient account of Stieltjes integrals yet to have appeared in a book, is also recommended to applied mathematicians. Stieltjes integrals, with their ability to handle both discrete and continuous cases at once, seem admirably suited for use in applied mathematics; however, up to the present time few applied mathematicians seem to have been aware of the potentialities of Stieltjes integrals. In this book the author uses Stieltjes integrals systematically, and is thus able to discuss both classical Laplace transforms and Dirichlet series as cases of the same general theory.

The book contains proofs of nearly all the auxiliary material which the author has used, and interesting applications of some of it to topics other than those strictly within the subject. Thus the theory of moment problems, introduced partly because a moment sequence is a discrete analogue of a Laplace transform and partly because some of the results are needed elsewhere in the book, is applied in a discussion of Hausdorff summability. Wiener's general Tauberian theorem (with Pitt's elegant proof) is applied not only to Tauberian theorems for Laplace transforms, but also to the prime number theorem (of which two proofs are given).

Other topics covered include regions of convergence of Laplace transforms; inversion formulas (both those involving contour integrals and those involving derivatives); necessary and sufficient conditions for the representation of functions as Laplace transforms; the iterated Laplace transform (or Stieltjes transform); absolutely and completely monotonic functions (no discussion of this last topic has previously been available in book form).

An experienced analyst will find in this book a large amount of useful material conveniently arranged and concisely expounded; a specialist will observe new theorems and new proofs of old theorems; a beginner will find important classical methods as well as problems at the frontiers of current research. The book contains ample refutation of the opinion, so frequently expressed nowadays, that "classical" analysis is a field in which interesting results are no longer to be expected.

R. P. BOAS, JR.

DUKE UNIVERSITY

MEDICAL PSYCHOLOGY

A History of Medical Psychology. By GREGORY ZILBOORG, M.D., in collaboration with GEORGE W. HENRY, M.D. 606 pp. New York: W. W. Norton and Company, Inc. 1941. $5.00.

THOSE students who have felt the need of a historical orientation in the subject of mental disorders are now presented with the first comprehensive history of medical psychology in any language. Valuable material of this character exists in brief articles distributed through the medical and philosophical literature of the ages, in Jelliffe's translation of Friedreich's writings, in Kannabich's history of psychiatry in Russian (1928), in the contributions of Calmeil, Lelut, Trélat and of the two Semelaignes, and in the essays of D. Tuke and T. Kirchhoff, but heretofore there has been no perspective offered in a systematized way.

Here one finds a description and an evaluation of the evolution of the concepts of mental suffering, of emotional illnesses and of personality disorders, along with the story of the whole development of culture and the struggle against mental illness.

To the primitive man, mental deviations were mysterious. They are still far from being well understood, and streaks of demonology are found at present in the midst of our modern culture and in the offshoots of our contemporary thinking. The section "Primitive and Oriental Medical Psychologies" contains the statement that mental disorder "whether viewed with the clouded vision of a very primitive man, through the mystic eyes of Mosaic law, or through the pantheistic glasses of the Hindu, remained a mystery, reprehensible or admirable, which did not belong to medicine."

It is pointed out that the first serious attempt to place mental disease on a scientific foundation was made by the Greeks, and in the section on the Greeks and the Romans the activities of Hippocrates, Plato, Aristotle, Cicero, Celsus and Aretaeus are emphasized. Galen, who added so much to the general medical knowledge of the times, is characterized as having "contributed nothing new either to the therapy or to the clinical description of mental diseases." Then came the "Great Decline," a period toward the end of the twelfth century when medical psychology as such became attenuated as a healing art and was gradually isolated from scientific consideration, almost to the point of extinction.

The sections entitled "The Restless Surrender to Demonology" and "The Blows of the Witches' Hammers" are among the most informative, constituting fascinating accounts of the current ideas and practices, including the incredible and horrible cruelty associated with "witch" trials and executions of those suffering from now-recognizable mental twists. The reaction from this state of affairs appears in the text as "The First Psychiatric Revolution," stressing among others the pioneer labors of Vives (1492–1540), Paracelsus (1493–1541), Cornelius Agrippa (1486–1535), Johann Weyer (1515–1588) and Jean Bodin (1530–1596), all of whom took active parts in attempts to unravel many complexities and to demonstrate that mental disorders were natural diseases and not the handiwork of the devil.

From the "Age of Reconstruction" during which there were many important creative movements, one is led to the period called "The Discovery of the Neuroses," at which time psychiatry was vitalized by the work of Mesmer, Braid, Charcot, Janet and a number of their contemporaries who had gained glimpses of the laws of the mind in action. The "Era of Systems" is described next, at which time the special trend in the direction of differentiation and classification of mental diseases was forwarded by the outstanding investigations of Esquirol, Falret, Tuke and Kraepelin.

The climax in this history of medical psychology is found in the "Second Psychiatric Revolution," which describes the researches and ideas of Sigmund Freud, psychoanalytic and other psychodynamic concepts, and their expansion into the various divisions of modern work and thought. The contributions of Adolf Meyer, A. A. Brill, W. A. White and S. E. Jelliffe are included here.

The history of the concepts of some of the organic mental disorders, such as general paresis, senile conditions and alcoholic reaction types has been ably presented by Dr. Henry. He has also contributed a very useful section on the history of the influences governing the building and organization of mental disease hospitals from the earliest times to the present, which includes the story of the dire conditions and sad state of the early asylums as compared with modern accommodations and humane treatment.

The approach is humanistic and the style of writing is spontaneous and vivid. Although it would require a number of volumes to include all the desirable details of the history of medical psychology, the book will take an important place in the literature of the medical sciences, where it will serve those interested in human psychology, and it should stimulate a demand for further expansion.

NOLAN D. C. LEWIS

COLUMBIA UNIVERSITY

SOCIETIES AND MEETINGS

THE SOUTHERN ASSOCIATION OF SCIENCE AND INDUSTRY

THE Georgia Academy of Science served as host at the second annual meeting of the Southern Association for the Advancement of Science at the Biltmore Hotel in Atlanta, on April 2 and 3. At this meeting it was agreed that the name of the organization be changed to The Southern Association of Science and Industry, in order that the participation of industrialists and business men in the organization might be more properly indicated.

With Dean Wortley F. Rudd, Medical College of Virginia, presiding, addresses were given before the association by Dr. W. B. Baker, Emory University, president of the Georgia Academy of Science, and Governor Eugene Talmadge, of Georgia. Dr. George H. Boyd, University of Georgia, president-elect of the association, spoke on "Some Basic Considerations in Building for Research in Southern Problems."

Panel discussions, open forums, etc., were conducted on important regional problems, and many southern and national leaders participated. Chairmen and topics of the various discussion groups included Dean C. F. Korstian, School of Forestry, Duke University, "Conservation of One of the South's Major Crops—Its Forests"; Dean Stewart J. Lloyd, University of Alabama, "The Teaching of Science in the Secondary Schools of the South"; Dr. Milton H. Fies, DeBardeleben Coal Corporation, Birmingham, Alabama, "As Others See Us"; and Dr. J. Sam Guy, Emory University, "Role of Scientific Research in the Development of Natural Resources of the South." Dean Rudd delivered the presidential address, entitled "Remarks," at the banquet, on Thursday, April 2, at 8:00 P.M.

Certain business matters, such as the constitution, reports of standing and special committees, were considered and agreed upon. It was further agreed that the incoming president should appoint a "Long Range Planning Committee" and a committee to make a survey of all research now being carried on in the South. The president was requested to appoint a committee to consider the possibility of increasing a service such as is now being rendered by Dr. E. Emmet Reid through visitation and technical advice to the various research groups in the South.

The original territory was changed to include all of Texas, and, upon insistence by representative residents, it was agreed that Maryland and the District of Columbia be added for membership in the Southern Association of Science and Industry. Several state academies and other state and regional science organizations have requested that they be affiliated with the association.

Officers elected were:

President: Dr. George H. Boyd, University of Georgia.

President-elect: Dr. Milton H. Fies, DeBardeleben Coal Corporation.

Vice-president: Dr. J. Sam Guy, Emory University.

Treasurer: Dr. L. B. Roberts, Arkansas A. and M. College, Monticello.

Secretary: Dr. George D. Palmer, University of Alabama.

Members of the executive committee:

E. Morrell, Maryland; Dr. Austin Clark, District of Columbia; Major W. Catesby Jones, Virginia; Dean C. F. Korstian, N. C.; Dr. James E. Copenhaver, S. C.; Dean Robert C. Wilson, Ga.; J. H. Allen, Florida; Dr. James T. Mackenzie, Alabama; Dr. W. F. Hand, Miss.; Dr. H. A. Webb, Tenn.; Dr. M. Scherago, Kentucky; Dr. Richard J. Anderson, Arkansas; Dr. E. F. Pollard, La., and Dr. Edward O. Heuse, Texas.

GEORGE D. PALMER,
Secretary

SPECIAL ARTICLES

STEROID HORMONE EXCRETION BY NORMAL AND PATHOLOGICAL INDIVIDUALS

A STUDY is in progress of the abnormalities of the intermediary metabolism of the steroid hormones which are associated with disease. As a part of this program a systematic investigation has been initiated involving the examination of individual urine collections in amounts adequate for extensive fractionation and chemical characterization of the constituent steroids. This note presents the findings to date from the processing of 2- to 6-month collections of urine from six normal persons, six patients with cancer and four patients with clinical evidence of hyperplasia of the adrenal gland.

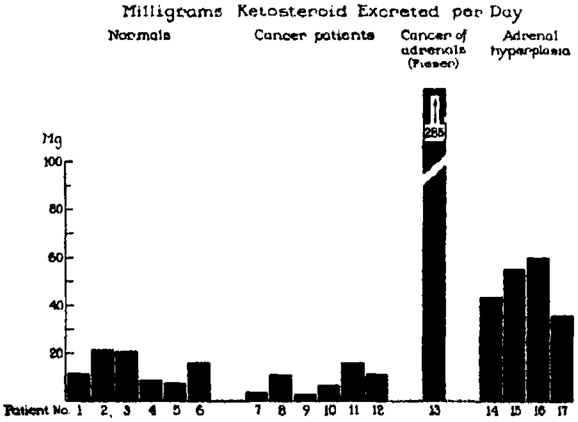

FIG. 1

After hydrolysis of the urine with sulfuric acid and extraction with ether, the extracts were partitioned into acidic, phenolic and neutral fractions. The neutral material next was separated with Girard's reagent (T) into ketonic and non-ketonic fractions. Each of these then was processed with digitonin into the 3-alpha- and 3-beta-ketosteroid fractions.

The 24-hour excretion rate of the total ketosteroids by the individuals studied, as estimated by the Callow modification[1] of the colorimetric method of Zimmermann,[2] are summarized in Fig. 1. Included for comparison are the results of a previous study (Fieser[4]). The cancer patients excreted, in general, smaller amounts than did the normal individuals and the patients with adrenal hyperplasia.

The average contents of digitonin-precipitated material (or 3-beta-hydroxy steroids) in the total ketosteroid fraction were: normals, 0.6–2.2 per cent.; cancer patients, 0.3–6.0 per cent.; patients with adrenal hyperplasia, 3.7–11.4 per cent. (Fig. 2).

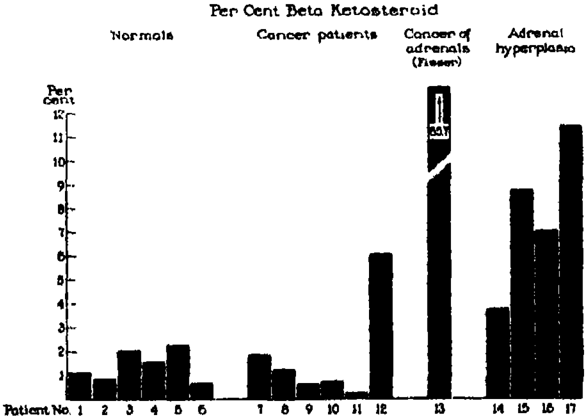

FIG. 2

The material not precipitated by digitonin (3-alpha-hydroxy-ketosteroids and 17-ketosteroids) was adsorbed from ligroin solution onto activated alumina (Brockmann) and separated by systematic fractional elution into the following fractions (Fig. 3):

Fraction I (elution with mixtures of petroleum ether and benzene). The presence in this fraction of $\Delta^{3,5}$-androstadienone-17[3, 4] was demonstrated in the material from four of six normals and from all the patients with adrenal hyperplasia. This was done by the isolation of the semicarbazone and oxime and

---

[1] N. H. Callow, R. K. Callow and C. W. Emmons, *Biochem. Jour.*, 32: 1312, 1938.

[2] W. Zimmermann, *Z. physiol. Chem.*, 233: 1935; 245: 47, 1936.

[3] H. Burrows, J. W. Cook, E. M. F. Roe and F. L. Warren, *Biochem. Jour.*, 31: 950, 1937.

[4] J. K. Wolfe, L. F. Fieser and H. B. Friedgood, *Jour. Am. Chem. Soc.*, 63: 582, 1941.

[5] H. Hirschmann, *Jour. Biol. Chem.*, 136: 483, 1940.

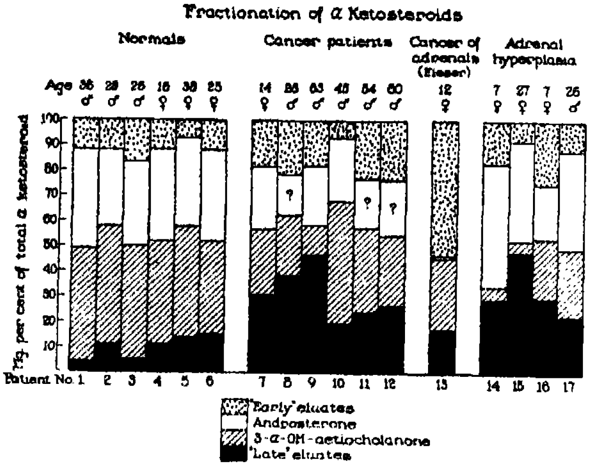

FIG. 3

by spectroscopic characterization. No chemical or spectroscopic evidence was found to suggest the presence of the dienone in urine collections from the two other normal individuals or from the patients with cancer. Androstenone-17[5, 6] was isolated from two normal urines and three hyperplasia urines (m.p. 114–114.5° C., $[\alpha]^{38}_{D} + 148°$ C.). It was identified by analysis and through the oxime. Androstenone-17 was not found in the urine of any cancer patient studied. The unidentified material of Fraction I had no characteristic ultraviolet absorption spectrum and gave no alcohol-insoluble semicarbazone.

The origin of the $\Delta^{3, 5}$-androstadienone-17 found in hydrolyzed urines is being investigated, and preliminary results based merely upon the identification of the dienone in suitably processed fractions by its characteristic absorption spectrum indicate that the substance can be detected in extracts of certain unhydrolyzed urines. It also appears, from the spectroscopic evidence, that acid hydrolysis of a urine previously devoid of any detectable amount of $\Delta^{3, 5}$-androstadienone-17, but to which dehydroisoandrosterone has been added, results in the production of a certain amount of the dienone.

Fraction II (elution with benzene and benzene-ether). Androsterone appears to be the chief constituent of this fraction. It was isolated from all collections except those from three patients with cancer (m.p. 177–178° C.). The androsterone was identified by analysis and by mixed melting point determinations of the hydroxyketone and its acetate with authentic samples. In Fraction II of the urine collections from the patients with evidence of adrenal hyperplasia certain apparently homogeneous substances were present which were not previously found in urine. One of these melts at 149–150° C., and another, isolated in amounts too small for analysis, melts at 134–135° C.

Fraction III (elution with ether and with ether containing 10 per cent. acetone). The chief constituent was identified as 3-alpha-hydroxyaetiocholanone-17 and was isolated in every instance (m.p. 143–144° C., remelting at 150° C., no depression in melting point on mixing the substance or its acetate with authentic samples).

Fraction IV (elution with ether-acetone, acetone and methanol). This fraction afforded a variety of substances. From two collections of normal urine and one of urine from a patient with evidence of adrenal hyperplasia there was isolated a substance, m.p. 199–200° C., which appears from the analysis to have the formula $C_{19}H_{32}O_3$ (Found: C, 74.30; H, 10.21). A second substance, m.p. 185–186° C., was isolated in traces from the urine of one patient with evidence of adrenal hyperplasia; it depresses the melting point of the 3-alpha-hydroxyandrostenone-17 isolated by Wolfe, Fieser and Friedgood[4] from the urine of a patient with adrenal tumor. A third substance, m.p. 232–234° C., was found in the urine of one cancer patient and, in larger amounts, in the material from three of the patients with adrenal hyperplasia. A fourth substance, m.p. 172–176° C., was isolated from the urine of a patient with evidence of adrenal hyperplasia, and other, so far impure, crystallizates have been encountered in this fraction.

Colorimetric assays were made of the total ketosteroid content of the four fractions of ketonic material not precipitated by digitonin. In the series of six normal urine collections, Fractions I and IV each constituted 5–15 per cent. of the total, and Fraction II (androsterone) and Fraction III (3-alpha-hydroxyaetiocholanone) together made up 70–90 per cent. of the total and were found present in the ratio 4:5. This finding is in confirmation of the observations of Callow and Callow.[7, 8] In the urine collections from patients with cancer the distribution of material was not as constant as in those from normal individuals and ratios between Fractions II and III were irregular. In three instances no androsterone was found in the Fraction II and, furthermore, Fractions I and IV were, with one exception, larger than normal. In the urines from adrenal hyperplasia patients, Fraction I usually contained 10–20 per cent. of the total ketosteroids, as was found in the material from normals, while Fraction IV contained distinctly more material than normal. On the whole, in the urine collections of the patients, both with cancer and adrenal hyperplasia, the ratio of the fractions varied

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[6] W. Pearlman, *Endocrinology*, 30: 275, 1942.

[7] N. H. Callow, *Biochem. Jour.*, 33: 559, 1939.

[8] N. H. Callow and R. K. Callow, *Biochem. Jour.*, 33: 931, 1939.

considerably from one individual to another and, as noted above, individual urine collections contained apparently specific and novel ketosteroids in Fractions II and IV. We are now endeavoring to accumulate quantities of these substances sufficient for chemical characterization.

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CONTROL OF FLOWERING WITH PHYTOHORMONES[1]

ATTEMPTS to influence flowering in *Ananas comosus* (L.) Merr. have involved experiments with certain synthetic phytohormones, including α-naphthaleneacetic acid, naphthaleneacetamide, naphthalenethioacetamide and a commercial product known as *Fruitone*. It has now been established that flowering can be induced in advance of the normal period or delayed until much later by the use of appropriate concentrations of these chemicals.

Typical data are given in Tables 1 and 2. Low concentrations of α-naphthaleneacetic acid (the compound used most extensively) applied as foliage sprays induced formation of inflorescences in advance of the normal period, but high concentrations, particularly when applied in solution at the apex, delayed flowering far beyond that of the controls. The fact that natural flowering of a uniform fall planting of slips occurs at a fairly definite season made it possible to schedule applications of the substances at desired intervals prior to normal differentiation of the inflorescence.

Flowering in *Ananas* involves a transition from the differentiation of vegetative structures to the formation of an inflorescence at the apical meristem. Steps in the process follow in succession, as already described.[2] The diameter of the meristem first widens, then flower bud primordia instead of leaf primordia are produced, and the peduncle elongates. The meristem gradually narrows again during the production of floral primordia and finally resumes differentiation of leaf primordia which give rise to the crown or top terminating the main axis of the plant.

An interval of about 2 months elapses from the time that the meristem first widens until the young inflorescence becomes externally visible in the center of the plant. From this fact it appears that the early stages in differentiation of the inflorescence must have followed shortly after the first application of the lowest concentration of naphthaleneacetic acid (Table 1). Conversely, differentiation of floral parts was greatly retarded by the highest concentrations (Table 2), although new leaves were formed after the applications which resulted in the longest delay in flowering. When early flowering was induced by the low concentrations of these chemicals there was no external evidence of abnormal development of tissues. When flowering was delayed for a long period of time, however, considerable distortion and constriction was observed in the portion of the stem and in the leaves at the level of the apical meristem at the time of application of the phytohormones.

TABLE 1

EARLY FLOWERING INDUCED BY DILUTE SOLUTIONS OF α-NAPHTHALENEACETIC ACID SPRAYED ON LEAVES FOUR MONTHS PRIOR TO NORMAL DIFFERENTIATION OF INFLORESCENCE

Concentration of solution Per cent.	Weekly applications No.	Plants No.	Plants which had formed flower buds at stated periods after first application	
			2 months No.	3 months No.
Controls	–	20	0	0
.001	6	20	20	20
.006	1	20	18	20
.006	3	20	9	19

TABLE 2

DELAY OF FLOWERING BY MORE CONCENTRATED SOLUTIONS OF α-NAPHTHALENEACETIC ACID POURED IN CENTER OF PLANT ONE MONTH PRIOR TO NORMAL DIFFERENTIATION OF INFLORESCENCE

Concentration of solution Per cent.	Biweekly applications No.	Plants No.	Plants which had formed flower buds at stated periods after first applicaton		
			4 months No.	6 months No.	8 months No.
Controls ..	–	20	19	20	20
.01	3	20	0	16	19
.05	3	20	0	1	7
0.1	3	20	0	0	3
0.1	1	20	0	18	20

Since the differentiation of the inflorescence itself was initiated (Table 1) in our experiments, the results differ from earlier uses of the same or similar phytohormones in the production of parthenocarpic fruits,[3,4] the hastening of flowering by seed treatments which accelerated growth[5,6] or premature flowering of tobacco which was said to be due to hastening of the terminal growth after the flower buds were formed.[7]

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[1] Published with the approval of the Acting Director as Technical Paper No. 139 of the Pineapple Research Institute of Hawaii, University of Hawaii.

[2] K. R. Kerns, J. L. Collins and H. Kim, *New Phytol.*, 35: 305–17, 1936.

[3] F. G. Gustafson, *Proc. Nat. Acad. Sci.*, 22: 628–36, 1936.

[4] F. E. Gardner and P. C. Marth, SCIENCE, 86: 246–7, 1937.

[5] K. V. Thimann and R. H. Lane, *Am. Jour. Bot.*, 25: 535–43, 1938.

[6] H. L. Stier and H. G. duBuy, *Proc. Am. Soc. Hort. Sci.*, 36: 723–31, 1939.

The initiation of flowering by these substances does not necessarily imply that they are "florigens"[8] since they have other effects on plant growth. Furthermore, acetylene and ethylene, compounds chemically quite unrelated to these phytohormones, also induce premature flowering in *Ananas*.[9,10]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SELF-STERILIZING SURFACES

IT is known that extremely small quantities of ionized silver can have a remarkable germicidal effect;[1] it has also been found that one must distinguish between effects produced by small silver ion concentrations in water (volume effect) and those occurring when microorganisms are brought into wetting contact with surfaces upon which Ag is absorbed (surface effect). In the former case the destruction of the organisms is mostly a matter of hours and a variation of the Ag concentration up to 2 parts per million produces no remarkable change in the rate of sterilization. Furthermore, it is difficult, if not impossible, to attack spores of bacteria, molds and yeasts. This behavior is quite at variance with the very rapid destruction of cells which come into close contact with the extreme Ag concentrations existing on surfaces with absorptive capacity for Ag. Here the destruction of large numbers of organisms is reduced to minutes.

This phenomenon suggests a practical application in the form of self-sterilizing surfaces with lasting activity, if the incorporation of an adequate supply of atomic silver which replenishes the surface continuously after a wetting contact can be realized. As many organic colloids, in particular the proteins, bind and thus remove the silver from the surface after contact with it, a disactivation results unless a process of replacement can be provided for.[2]

The conditions for the permanency of the self-sterilizing qualities is thus the use of a material which (*a*) exposes at the surface only a small fraction of its total silver content, (*b*) holds this fraction in a form almost insoluble in water but available to proteins, (*c*) protects the unexposed supply against chemical attack, (*d*) permits replacement by diffusion.

Numerous organic liquids could fulfil these conditions, but most practical applications of such surfaces require rigidity. The only rigid substances with adequate properties are vitreous materials of anorganic (glasses) or organic (plastics) nature. The diffusion rate appears to be too small for the former (unless in colloidal form), and even of the plastics only certain types have so far been found to provide for sufficiently fast exchanges.

The compounding of silver with the resins can occur in various ways, either by the dissolution or the colloidal dispersion of silver compounds into the monomers or half-polymers of a resin or by their dissolution or dispersion in solvents of the plastic.

The additional incorporation of stabilizing as well as plasticizing substances is important, also intransparent neutral filling materials are required where a protection of the interior of the material against photochemical effects on the silver content is needed.

The resulting compounded substance represents then a varnish-like viscous fluid which can be applied by brush, spray or impregnation to various bases like plastics, glass, wood, paper, cloth, etc. It is hardened *in situ* either by polymerization or evaporation of the solvents. These surfaces are tasteless and odorless, resist mechanical wear and chemical attack by weak acids and alkali solutions as well as boiling water. They are, however, sensitive to certain organic solvents. The amount of silver removed from the surface by, *e.g.*, touch with the lips is of the order of micrograms, *i.e.*, negligible from the toxic angle. The total quantity of silver which the surface material must contain varies widely with the intended use of the surface and with its intended degree of permanency, it amounts to approximately one gram of silver for 1,000 cm^2 of exposed surface for the heaviest type of duty so far developed.

By the choice of the proper resin, its degree of polymerization, quantity and type of filling materials, etc., it is possible to vary the rate of Ag replacement, the absorptive capacity for water as well as the hygroscopic qualities of the surface. Hence surfaces which will be wet most of the time and come in frequent touch with large quantities of protein-like substances must have a high replacement rate but a low water permeability in order to prevent a premature exhaustion of the incorporated silver supply, while surfaces mostly dry require certain hygroscopic properties and an appreciable water permeability. Consequently the performance for which a particular surface material is designed represents by necessity a compromise between the rate of sterilization per unit area, the rate of replacement and the total "life time" required for the surface.

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[7] A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 7: 447–476, 1935.

[8] M. Kh. Cajlachjan, *Compt. Rend. Acad. Sci., U. S. S. R.* (N.S.), 4: 79–83, 1936.

[1] Other metals, like gold and copper, share this property with silver at least to some extent. The reason for the particular focus on silver is due to its lack of toxicity compared with copper and its economic advantage over gold. It appears certain that similar materials can be developed with the incorporation of, *e.g.*, copper.

[2] The use of metallic silver surfaces may appear obvious because of the infinite supply of atomic silver. It is, however, easily demonstrated that metallic silver, even if very clean, is soon disactivated due to the formation of germicidally inert compounds.

[9] A. G. Rodriguez, *Jour. Dept. Agric. Porto Rico*, 16: 5–18, 1932.

[10] K. R. Kerns, "U. S. Patent No. 2,047,874," 1936.

The method used for testing the germicidal activity of these surfaces was the following: Samples of the surface material (about 6 cm^2) on various bases were placed in humidified containers (for preventing bacterial destruction by drying). The test microorganisms suspended in the desired medium were pipetted onto the surface in volumes of 0.05–0.1 cc, spreading the liquid into a film. Analogously the controls were obtained on neutral surfaces. At definite time intervals this film or part of it was removed by a sterile cotton swab, and was immediately introduced into 9 cc of lactose-beef or thioglycollate broth. After incubation at 37° C. for 1 to 5 days the growth was determined. A similar technique was applied for the quantitative determination of cell reduction by titration: the entire film was absorbed by the swab, the latter then soaked for 30 minutes in nutrient broth with frequent shaking before 1 cc was serially diluted and plated in nutrient agar. Colony counts were made after three to five days.

The test microorganisms used so far have been *E. coli, Staph. aureus, B. proteus, B. subtilis Cl. pasteurianum, Penicillium, Rhizopus* and *Sacch. cerevisiae.*

Distilled tap and peptone water, nutrient broth, 5 per cent. sucrose and dextrose solutions, cider and milk have been used as suspending media.

The germicidal action obtainable with various surface materials according to extended tests with the above methods are briefly this:

The rate of sterilization varies with the composition of the surface, the highest rate measured sterilizes *E. coli* at 10^8 cells/cc in less than one minute. Materials requiring rates of more than 5 minutes for *E. coli* at at least 10^5 cells/cc were discarded. The bacterial concentration does not influence in general the rate of sterilization.

For a given surface this rate does not vary appreciably with different types of organisms (except for spores). Mold suspensions containing high concentrations of spores were readily sterilized in all suspending media except nutrient broth and milk. This was demonstrated by exposing heavy mold suspensions in cider and sugar-peptone solutions for 1 to 5 minutes to surfaces applied within standard bottle caps, before applying them to 12-ounce bottles containing sterile cider or broth. After sealing, the nutrient was kept in permanent contact with the cap. Subsequent incubation (30 to 60 days) did not produce growth in any bottle, while control bottles with untreated caps showed heavy growth. For bacterial spores (*B. subtilis,* 10 days old, washed and heated to 100° C. for 5 minutes) reduction up to 97 per cent. has been obtained after 15 to 30 minutes exposure.

In general the rate of disinfection depends upon the concentration of protein-like matter in the suspending medium. In this respect milk is most severe, and a surface which destroys *E. coli* in water in about 2 minutes requires 15 to 30 minutes for the sterilization of non-sporulating bacteria in milk.

Endurance tests for various surface materials were made on a special testing machine, which dipped each sample every fifth minute for about 30 seconds into H_2O. At arbitrary intervals the above test was performed and it was found that the activity remained practically unimpaired for up to 30,000 infections over a period of 2 months. The final failure coincided in general with the destruction of the plastic surface by mechanical wear.

Without such treatment good surfaces have not shown disactivation during storage.

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R. TRACY
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THE VENOPRESSOR MECHANISM

By Professor YANDELL HENDERSON

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"WE have yet to explain in what manner the blood finds its way back to the heart from the extremities by the veins." So wrote William Harvey:[1] and now 300 years later the explanation is still not wholly complete. As a major factor in the venous return, Harvey described the valves in the veins and showed, by moving a finger along a vein in the arm, that "while these valves readily open in the right direction," *i.e.*, toward the heart, they "entirely prevent all contrary motion." And he accompanied the description with a drawing, copied from Fabricius,[2] showing a man's forearm with a ligature above the elbow and the hand grasping a rod, while the veins swell. In the grip of the hand in that drawing is the first suggestion of a venopressor mechanism.

It is always dangerous to read subsequent knowledge back into the words of the first author in any field. Yet one can not resist the impression that Harvey, in this drawing along with his account of the valves in the veins, recognized that the vigorous contraction of the muscles of the forearm propels blood from the muscles into the veins and on toward the right heart. If so, he would have been entirely in accord with the modern view that any muscle that is rhythmically relaxed and contracted, so that its capillaries are alternately filled from the arteries and emptied into the veins, acts as a peripheral pump, a "booster,"[3] aiding the venous return of the blood and the diastolic filling of the heart.[4]

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[1] W. Harvey, "The Motion of the Heart and Blood in Animals." London, 1628. Chap. 13. Everyman's Library, New York, 1906. Also translation by C. D. Leake, published by C C Thomas, 1931.

[2] H. Fabricius, "DeVenarum Ostiolis," 1603. Translation by K. J. Franklin, published by C. C Thomas, 1933, pp. 80, 81.

[3] Booster: A pump used to increase the pressure of

How well the intramuscular blood vessels are arranged to act the part of such peripheral blood pumps is clearly described by Krogh.[5] He writes:

> The arteries supplying a muscle branch freely and between the branches there are very numerous anastomoses forming a primary net. . . . The capillaries unite into venules intercalated between the arterioles, and the whole system of veins reproduces and follows almost exactly that of the arteries. All the veins down to the smallest branches are provided with valves allowing the blood to flow in the direction of the heart only. When the muscle contracts its form is greatly altered, the fibers become much shorter and proportionally thicker, . . . The blood is driven out by compression from a number of the venous branches and, when the muscle relaxes again, these can be filled from the peripheral end only. Since muscular contractions usually more or less regularly alternate with relaxations the system of valves makes of the veins of each muscle a very effective pump. . . .

So the muscles provide a venopressor mechanism to meet the increased demands on the circulation which the muscles themselves create during periods of physical exertion. There can be little doubt that it is largely by such peripheral aid to the venous return that the enormous increase in the output of the heart—at least five fold—during vigorous muscular exertion is made possible.

But suppose the exertion ceases and the man stands quite still, or sits down, or lies down and rests so completely that for a time no muscle in his body makes any visible movement, or does any external work. Does the pumping action of the muscles cease entirely? Is the venous return then wholly dependent upon the vis a tergo imparted by the heart and transmitted through the arteries and capillaries into the veins, and so onward to fill and distend the right heart? In other words, to paraphrase Harvey's question, "could the blood find its way back to the heart from the extremities by the veins" without some peripheral aid? There is strong evidence that it does not, and that it could not; but that at least in health there is constantly active peripheral aid to the venous return. It is only in the state called shock and other conditions of profound physical depression that this booster action fails. The testimony now to be cited indicates that even in the most complete state of healthy rest and quiescence the muscles are still pumping and that the venopressor mechanism, as above described, is still active so long as the motor centers in the spinal cord continue to discharge nervous impulses into the skeletal muscles in the maintenance of tonus.

MUSCLE TONUS AND ITS CONTROL

Sherrington,[6] in his classic analysis of the proprioceptive reflexes by which muscle tonus, body posture and facial expression—and to a considerable extent also basal metabolism—are maintained and adjusted, showed decisively that even when the body is at rest, and appears to be entirely motionless, the skeletal musculature is far from flaccid. On the contrary, as he expressed it, "the greater part of the skeletal musculature is all the time steadily active."

More recent studies, such as those of Adrian[7] and Adrian and Bronk[8] on single nerve fibers, have confirmed the conception that the mode of behavior of all the nerve-muscle mechanisms involved in external motion and active work holds equally true of the tonic contractions of the muscles that maintain posture even in normal rest. Between the states of bodily exertion and muscular rest, apparently so different, the form of activity within the muscles is exactly the same: varying only in degree.

In the so-called "isometric contractions," that tonus maintains when a man is standing or sitting, and even when lying down, the muscles do not shorten and do no external work. They do, however, exert an elastic pull to maintain posture. A weak pull of this type, which for lack of a better term is here called tonus, is due to impulses from motor centers in the spinal cord over only a few nerve fibers which induce contractions only in correspondingly few bundles of muscle fibers; but the impulses over each of these nerve fibers and the contractions, or elastic pulls, of each of the bundles so stimulated are maximal. A stronger pull of the muscle is due to impulses over a greater number of nerve fibers and a more rapid succession of impulses in each fiber, which stimulate a greater number of bundles of muscle fibers: the bundles contracting, or pulling, not all together, but in relays and rotation.

Contrariwise, as the activity of a muscle decreases to lower and lower degrees of intensity, until it is apparently wholly quiescent and doing no external work whatever, nervous impulses pass over fewer and fewer nerve fibers from the motor centers, and fewer and fewer groups of muscle fibers are at any instant active. Yet it appears probable that no living muscle is ever allowed to cease its tonic pull completely.

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fluids. Webster's New International Dictionary. Second Edition. Unabridged, 1934.

[4] Y. Henderson, "Adventures in Respiration." Williams and Wilkins Company, 1938.

[5] A. Krogh, "The Anatomy and Physiology of Capillaries," p. 208. Revised edition. Yale University Press, 1929.

[6] C. S. Sherrington, "The Integrative Action of the Nervous System," p. 340. Charles Scribner's Sons (for Yale University) 1906.

[7] E. D. Adrian, "The Mechanism of Nervous Action." University of Pennsylvania Press, 1935.

[8] E. D. Adrian and D. W. Bronk, *Jour. Physiol.*, 67: 119, 1929.

Always a few of the motor nerve fibers to it are discharging impulses into it, and a few of its bundles of muscle fibers are stimulated to contract.

Such, as nearly as the picture can be constructed from the experimental data now available, is the state of continual internal activity which is skeletal muscle tonus. It is a state which no part of the body loses completely except at death. So long as it is maintained it involves continuance of the pumping action of the discrete muscle bundles relaxing and contracting one after the other and thereby filling, compressing and emptying their intercalated capillaries and veins in the manner that Krogh[5] has described for the muscle as a whole.

The action of these minute pumps is the principal, but not the only, aid that muscle tonus affords to the venous return. A longitudinal pull on such a structure as a muscle necessarily induces a general internal pressure; and a pressure anywhere in a system permeated with collapsible vessels containing a fluid tends to cause the fluid to flow toward any point where the pressure is lower. That is the basic conception of hydraulics and hemodynamics. If, then, the state of tonus in muscles maintains an intramuscular pressure higher than that of the atmosphere about the body, and the pressure in the thorax is subatmospheric—the two pressures together constituting the effective venous pressure—the tonic intramuscular pressure must aid the venous return that distends the right ventricle. That such intratissue pressures do normally exist is now demonstrated by a considerable literature.[9] They are measured by determining the pressures required to force a minute amount of a saline solution through a hypodermic needle into a muscle or other tissue; and the pressures so demonstrated are found to vary according to the tension on the muscles: that is, their tonus. By maintaining pressures upon other tissues, as in the abdomen, muscle tonus conserves in the capillary blood some of the energy that the heart has imparted and tends to press onward toward the veins the blood which the arterioles throw into them.

THE ELECTROMYOGRAM

Every time that a muscle fiber contracts it manifests its activity by an electrical event, the so-called action current. If, then, a muscle such as the biceps in a man's arm containing hundreds of separate muscle bundles is maintained in a state of tonus, the number of bundles that are thrown into contraction at any instant should be revealed in the electromyogram. In other words, the number of electrical impulses appearing in such a graphic record should indicate the number of minute capillary and venule pumps that are making discharges toward the heart. If this is correct, a series of such electromyographic records made at times when the biceps is entirely immobile externally, but under different degrees of tension, should show varying degrees of electrical activity corresponding to the degrees of tension. Accordingly, at my request, my colleagues of the Section of Neuro-Anatomy have recorded the series of electromyograms which are here reproduced. They reveal that the biceps of a man lying at rest with his arm relaxed, as in the first record, or perfectly quiescent under slight strain, as in the other records, is "all the time steadily active." They show that the number of bundles of muscle fibers in a muscle that are nervously activated varies with the intensity of the longitudinal pull that the muscle maintains. And the same evidence, interpreted in accord with Krogh's description, indicates that the number of minute pumps that are actively aiding the venous return to the heart varies correspondingly.

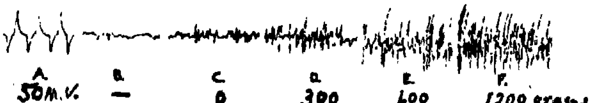

FIG. 1. Showing graphic records of the electromyogram of the biceps brachii under increasing tension: *i.e.*, the electrical discharges accompanying the contractions of an increasing number of muscle bundles and the corresponding strokes of the capillary-venous booster pumps. (A) Calibration, 50 micro volts. (B) Subject lying supine, arm beside body, biceps "at rest." (C) Biceps contracted sufficiently to hold the elbow flexed at 15 degrees. (*D*) Same position, 300 gram weight in hand. (E) Same position, 600 gram weight in hand. (F) Same position, 1200 gram weight in hand. Arm perfectly quiescent during the taking of each record. Records by courtesy of the Section on Neuro-Anatomy. (Graph by L. F. Nims.)

THE TONIC ACTIVITY OF THE MOTOR CENTERS

Skeletal muscles have little intrinsic activity. Unlike cardiac muscle their behavior is imposed upon them from the central nervous system. To trace the various influences that act upon the accessory blood pumps in the muscles, we must therefore look behind the muscles to the motor centers in the spinal cord which innervate them. Yet it is only by the behavior of the muscles that we can judge how various influences affect the state of their motor centers.

As the means of testing that state two types of experiments are available. One is by means of what Sherrington has termed "proprioceptor reflexes," of which the most convenient is the knee jerk. For this purpose the thigh must be supported and fixed in an unchanging position and the taps on the patella tendon must be applied at uniform intervals by a light hammer falling through a uniform distance. With this arrangement it has been found that virtually any and all events anywhere in the body affect the knee jerk either to an increase or decrease: inspiration, expiration, clenching a hand, mental arithmetic, somnolence, a sudden loud sound, and so on almost endlessly are such influences. In the present connection, the most significant influence upon the motor centers is, however, chemical: the influence of the blood gases. Thus as Henderson, with the collaboration of Coffey and Barnum,[10] found, a period of forced overbreathing sufficient to induce a slight acapnia (deficiency of carbon dioxide in the blood) and a subsequent brief period of failure of breathing, was followed also, for a slightly longer time, by the abolition of the knee jerk also. Contrariwise rebreathing from a small bag, until enough carbon dioxide had accumulated in the blood to induce a slight increase in the volume of breathing, induced a marked augmentation of the knee jerk. These facts suggest strongly that the blood gases, particularly carbon dioxide, exert an influence upon motor nerve centers that is manifested in muscle tension and the activity of the intramuscular booster pumps essentially as the blood gases are known to influence respiration. In other words, under ordinary normal conditions the amount of carbon dioxide produced in the body determines both the volume of air breathed and the volume of blood circulated. In this way, as Miescher[11] first recognized, the oxygen supply of the body is safeguarded by carbon dioxide.

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[9] Y. Henderson, *loc. cit.*, p. 243; also J. D. Kerr and L. D. W. Scott, *Brit. Med. Jour.*, 2: 758, 1938; W. Beigelbock and H. Jung, *Zeitschr. f. klin. Med.*, 131: 242, 1937; H. S. Wells and H. S. Youmans and D. G. Miller, Jr., *Jour. Clin. Invest.*, 17: 489, 1938; F. A. Hillebrandt, E. J. Crigler and L. E. A. Kelso, *Am. Jour. Physiol.*, 126: 247, 1939.

The other experimental method by which it is possible to test the state of motor centers in their control of muscle tonus has more recently been employed by Henderson and Turner[12] in their study of artificial respiration. They have shown that it is the "elasticity" of the thoracic muscles and diaphragm which makes artificial respiration possible; that this feature of these and other muscles is not a mere mechanical elasticity, but a vital property due to tonus under nervous control; and that in a normal man under artificial respiration it is the blood gases acting upon the respiratory center and its subordinate motor centers that determine the degree of tonic elasticity in the muscles that they innervate. These findings, which are in general accord with those of Hess[13] in experiments on animals, are of particular interest in view of the campaign for the teaching of First Aid by the American Red Cross just now, as this teaching includes the Schafer prone pressure method of artificial respiration. Evidence both in the laboratory and in cases of drowning, electric shock and carbon monoxide asphyxiation indicates that inhalation of a mixture of carbon dioxide and oxygen by increasing the tonic elasticity of the respiratory muscles is a valuable aid to manual artificial respiration in essentially the same way that it increases natural breathing. Both types of evidence show also that such devices as pulmotors, resuscitators, and other suck and blow apparatus are highly unphysiological and may actually do harm. An even greater practical objection to such mechanical devices is that they take time to apply and thereby delay the all important immediate application of artificial respiration. As tonus quickly fails in cases of asphyxia, drowning and electric shock, a delay of a few seconds often causes the loss of a life.

PERIPHERAL CIRCULATORY FAILURE AND ASPHYXIA

Whenever, as a consequence of acute illness or physical injury and pain, some of the centers in the nervous system break down and fail in their normal function, one of the accompanying manifestations is a failure also of the circulation. The nervous failure was formerly assumed to be primarily in the vasomotor centers, and to induce a relaxation of the peripheral blood vessels. To that conception the venopressor mechanism now affords an alternative. But no matter whether the primary failure is in the vasomotor control over the arteries and arterioles with pooling in the splanchnic area, as heretofore believed; or whether, instead, the failure is in the spinal motor centers with loss of muscle tonus and slowing of the blood stream in the flaccid muscles, as here presented, the result is the same: a slowing of the blood stream.

Given a progressive slowing of the blood stream leading to peripheral circulatory failure and the first stage of shock, the next problem is that of how the second stage develops from it: that stage consisting in a decrease of blood volume which further diminishes the venous return and the minute-volume of the circulation.

In health the blood stream is so large, or rather so *rapid, that in each minute it brings to the tissues* a large excess of oxygen; and the excess goes on into the venous blood. When, however, in the development of shock or in the prostration of acute disease, the venopressor mechanism gradually fails, the venous return grows less and less, the circulation progressively slower and slower. Consequently the excess of oxygen brought to the tissues becomes smaller and smaller, until none is left to pass on into the venous blood. The arterial blood is still fully loaded with oxygen, but as the volume-flow decreases a point is finally reached at which the demands of the tissues are no longer met.[14] Tissue asphyxia then develops, and with it a process analogous to edema. The walls of the capillaries become permeable;[15] and the serum of the blood and some corpuscles ooze out into the tissues. Three interacting results follow: oligemia, bradyrhea,[16] and asphyxia: *i.e.*, decrease of blood volume, slower and slower flow of blood through the tissues and finally anoxia of the tissues.

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[10] Y. Henderson, *Am. Jour. Physiol.*, 25: 310, 1910.

[11] F. Miescher, *Arch. f. Anat. u. Physiol.* Physiol. Abth., 1885, p. 355.

[12] Y. Henderson and J. McC. Turner, *Jour. Am. Med. Asn.*, 116: 1508, 1941.

[13] W. R. Hess, "Die Regulierung der Atmung." Georg Thieme, Leipzig, 1931.

Such appears to be the causal sequence through which failure of the tonic activity of the motor centers initiates the development of shock. That this sequence is essentially correct is confirmed by the benefit which is now obtained from the intravenous administration of serum. In shock, if accompanied by little or no hemorrhage, the red corpuscles, which are the oxygen carrying portion of the blood, are still in the body, but stagnant, and need only serum to float them. The benefit afforded by mere serum in shock serves to distinguish shock from hemorrhage; for serum alone, even when reinforced by inhalation of oxygen, as it should be, can transport little oxygen. After an exsanguinating hemorrhage, on the contrary, the essential and only means of saving life is restoration of at least some part of the red corpuscles by infusion of whole blood.

Similar in appearance as are the effects of extreme hemorrhage to those of shock from venopressor failure, hemorrhage[17] has an even closer fundamental likeness to carbon monoxide asphyxia, in which the corpuscles are deprived of their capacity to transport oxygen. Yet in their final stages, hemorrhage and shock are as truly forms of asphyxia as is the tissue anoxia induced by carbon monoxide. In all three conditions, the fundamental need is oxygen;[4,18] but the best method of restoring the supply of oxygen in each is different.

ESTIMATION OF THE VENOUS RETURN

Solution of the problems of circulatory failure has been greatly retarded by the lack of a simple method for estimating the volume of the venous return in health and disease. Under just those conditions of failing vitality in which it is most important to follow the decrease or recovery of the venous return, venous pressure is often immeasurably low. It has, however, been found[19] that significant measurements can be made quite easily when the body is inverted at least to such a degree—a slope of 1:4—that all the blood returning from the tissues is—so to speak—poured into the great veins near the heart: the preventricular reservoir of von Recklinghausen. Although this head-down position is not so much of an aid to the circulation as surgeons generally believe, it is of great value for diagnosis. For when one of the patient's arms is then held vertically, or lifted gradually, the top of the column of blood in the veins usually shows a sharply defined meniscus, and the height of that column above some point of reference, such as the symphysis of the clavicles, affords an index of the volume of the venous return. Estimated in this way that volume has been found to be greatly decreased after some major surgical operations and in cases of acute illness. As recovery develops the venous column rises again; as vitality fails, the column sinks progressively lower until it reaches zero as the tonus of the body's musculature disappears at death.

MILITARY GEOLOGY FROM THE AIR

By Professor JOHN L. RICH

UNIVERSITY OF CINCINNATI

THIS paper is written to call attention to the existence of a small body of men competent to perform a new and unique service in the war effort—the interpretation and mapping of geological information of military value revealed on aerial photographs.

The present war, with theaters of activity in regions little known and poorly mapped or entirely unmapped, many of them in enemy hands and inaccessible for study on the ground in advance of occupation, makes it necessary to depend almost entirely on aerial photographs for both topographic and geologic information concerning areas about to be invaded.

Army engineers have developed methods of interpreting the topography and of preparing topographic maps from the photographs, but they can not be expected to be able to read from the pictures the numerous items of geologic information that may be useful in planning military operations. Among these are the nature of the bedrock—whether hard or soft with all that this implies as to depth of soil, ease of road-building and of all kinds of excavation; whether massive or bedded, and if the latter, whether the beds are horizontal or gently or steeply tilted—features which likewise bear significantly on problems of excavation and ground water supply; whether comparatively undisturbed or badly crushed and broken, and hence difficult to tunnel or mine.

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[14] Y. Henderson, *Am. Jour. Physiol.*, 25: 395, 1910; 27: 152, 1910; Y. Henderson and S. C. Harvey, same journal, 46: 553, 1918; Y. Henderson and T. B. Barringer, Jr., same journal, 31: 289, 352.

[15] E. M. Landis, *Physiol. Rev.*, 14: 404, 1934; C. K. Drinker and J. M. Yoffey, "Lymphatics, Lymph and Lymphatic Tissue," p. 279. Harvard University Press, 1941.

[16] From *βραδύς* slow and *ῥοία* flow. With thanks to my classical colleague, Professor G. L. Hendrickson.

[17] Y. Henderson and H. W. Haggard, *Jour. Am. Med. Ass.*, 78: 697, 1922.

[18] Y. Henderson and H. W. Haggard, "Noxious Gases" (revised edition), Reinhold Publishing Company, 1942.

[19] Y. Henderson and H. W. Haggard, *Jour. Pharmacol.*, 11: 189, 1918.

Of equal importance are: features associated with streams such as floodplains liable to inundation, terraces with their well-drained but soft and easily trenched subsoil; deposits of structural materials like sand, gravel or limestone needed for road-building and other construction, which can often be recognized from the air by the trained geologist; and conditions affecting underground water, whether in relation to drinking water supplies or to drainage.

These are only a few of the numerous geological features of military significance which the men of whom I am writing should be able to recognize and interpret from the aerial photographs.

The men competent to perform such services are geologists who combine in their training and experience all the following essentials: (a) Thorough training in geomorphology, the science of land forms, which enables them to recognize by their topographic expression a wide variety of geologic structures and of earth materials. (b) A broad and varied field experience, for it is only through such experience that a geologist gains the high degree of competency necessary for the interpretation of the multiplicity of features likely to be encountered in our present and future theaters of war activity. (c) Experience in actually seeing and interpreting from the air the greatest possible variety of geologic features, and finally, (d) experience in the actual interpretation of aerial photographs and comparison of the appearance of various geological features in the photographs with their appearance on the ground. For this aspect of the geologist's preparation, actual experience in using aerial photographs in the field as base maps for geologic mapping is particularly valuable.

The reason why a geologist with the training and experience outlined above can read so much of the geologic story in aerial photographs, even though they may have been taken in wooded country, is inherent in the fundamentals of the science of earth forms with which the geologist is familiar. He knows what kinds of forms are produced by streams, wind, glaciers or landsliding and how to recognize (within limits) the various kinds of bedrock such as granite, shale, limestone or lava by the distinctive forms into which they are carved by erosion. He is familiar with the differential etching of the earth's surface by weathering and erosion, whereby areas underlain by weak rock are lowered while those underlain by resistant rock stand out in relief, and he is expert in interpreting the structure or "lay" of the rocks by the relief features so produced.

Because the kinds of rock and their structures are thus revealed through the way in which they are affected by the agencies of erosion, the experienced geologist with the training outlined above is able, from photographs alone, to supply a large amount of militarily useful information about an unknown region in advance of its occupation by ground forces. No one but the geologist so trained is in position to do this, because the experience and background training involved can neither of them be acquired in a short space of time. Experience is more or less proportional to the time the geologist has spent in actual field work on the ground and in reconnaissance from the air and study of aerial photographs directed specifically toward the recognition of various types of terrain.

Comparatively few of the geologists of the United States are now competent to do this because comparatively few have had all the required elements of training and experience listed above. Yet those few may be able to render service of inestimable value if stationed at regional staff headquarters. A larger number, lacking perhaps only experience in interpretation of photographs, or in viewing the ground from the air, could however become reasonably competent after a few weeks or months of special training.

The training that most geologists have had, even though through lack of experience they may not be qualified for the work outlined above, tends to make them more than ordinarily competent to carry on the more general types of work in connection with the interpretation of aerial photographs.

Considered broadly, there appear to be four aspects of the interpretation of such photographs: (1) The interpretation of cultural and military features, such as roads, trails, gun emplacements, tracks and trails made by troops, artillery convoys, and so forth. (2) The interpretation of relief. (3) The use of aerial photographs for map construction, and finally (4) the interpretation from the photographs of geologic features as outlined above. Considering each of these aspects in turn:

(1) As to the location of ordinary cultural and military features, men trained in geology probably can not do much more than other reasonably keen and intelligent persons (especially those with some previous military training) will be able to do after a certain amount of practice in the interpretation of

photographs, except that the geologists are much more likely to be able to recognize camouflage as not being in harmony with the natural landscape.

(2) As to relief *per se,* the man with geological training probably will have a decided advantage in recognizing relief features on non-stereoscopic pictures because he will have a comprehension of relief as a systematic topographic expression associated with drainage lines or rock structures, and therefore may be able to infer from drainage lines and vegetation patterns relief features which would not be evident to the untrained observer. Even with stereoscopic pictures the fact that the features automatically fall into logical and therefore easily remembered patterns gives the geologist a distinct advantage.

(3) As to the methods of construction of maps from aerial photographs, geologists in general are not in position to contribute anything not already known and practiced by the Army Engineers. As actual workmen, however, engaged in map-making from the photographs, geologically trained men should have a distinct advantage over others because they are in the habit of using maps and even of making maps of both topographic and geologic features, and consequently should be in position to do effective work much more quickly than men without such training.

As to (4), the interpretation of terrain, that, as I have tried to make clear above, is a field for the few highly trained specialists. It is a field so new that its possibilities are not likely to have been fully realized by army commanders or even by geologists themselves.

In view of the world-wide nature of the present conflict and of the comparatively unknown character of much of the territory over which operations must be conducted, a technique such as the geological interpretation of aerial photographs of areas that can not be examined on the ground promises to yield information of the greatest importance that can not be obtained in any other way.

OBITUARY

C. HART MERRIAM

DR. C. HART MERRIAM, one of the stalwarts of the scientific world, died on March 19 at the age of 86, in Berkeley, Calif. Physician, naturalist, ethnologist, explorer, scholar, lecturer, author, personal friend of Presidents—he was a prominent figure of two generations.

From early boyhood in the Adirondack region of New York, his dominant interests were in the field of natural history. Beginning about 1867 with insects and birds, his activities soon expanded to cover mammals and reptiles, then marine invertebrates and plants. When only 16 (in 1872) he was appointed by Professor Spencer F. Baird, assistant secretary of the Smithsonian Institution, as naturalist of the Government Survey of the Territories (known as the Hayden Survey) and he made extensive collections in Utah, Idaho and Wyoming. In 1875, while a student at Yale, he was summer assistant on the U. S. Fish Commission at Woods Hole, Mass. Following graduation from the College of Physicians and Surgeons, Columbia University, in 1879, he practiced medicine and surgery in northern New York. In 1883, as surgeon of the *SS Proteus* he visited the Newfoundland seal fisheries on the ice floes between Labrador and Greenland.

In 1891 President Harrison appointed Dr. Merriam as Fur Seal Commissioner to represent the United States on a joint American and British commission to study the problems of pelagic sealing on the Pribilof Islands. In 1899 he again visited Alaska and the Bering Sea, on the Harriman Alaska Expedition, whose scientific personnel he selected.

While studying in the museums of England, Holland and Germany, in 1885, he was recalled to organize a division of ornithology in the Department of Agriculture, and soon converted it into the U. S. Biological Survey, of which he was chief for twenty-five years. During this epochal period of investigation, in which he played so important a part, he made field studies or led biological explorations (mainly by pack-horse outfits and most frequently accompanied by Vernon Bailey, long chief naturalist of the Biological Survey) in every state and also in Bermuda, Canada and Alaska. Among the more important of these surveys in the Far West were those of San Francisco Mountain, Arizona, including the Painted Desert and a section of the Grand Canyon; the Death Valley region and neighboring deserts in California, Nevada and Utah; the Snake Plains and adjacent mountains in Idaho, and Mount Shasta in northern California.

In addition to their many other scientific values, these and other explorations were proving grounds for Dr. Merriam's development of the laws of temperature control of the geographic distribution of animals and plants in North America. His life-zone concepts have been widely accepted by the scientific world.

He was a member of the U. S. Board on Geographical Names for twenty years and chairman for eight years. Two natural landmarks bear his name: Mount Merriam in California, amongst the group of High Sierra peaks that have been named for eminent scientists, and Merriam Crater in northern Arizona. He was the last of the original founders of the National Geographic Society, on whose board of directors he served continuously for 54 years.

In 1910 Dr. Merriam resigned from the Biological Survey to continue natural-history and ethnological investigations under a special fund established in the Smithsonian Institution by Mrs. E. H. Harriman. Since that date he has devoted the major portion of his time to ethnological studies of the native Indian tribes of the Far West and to the betterment of their condition. He was an authority on distribution, languages, mythology and basketry of the tribes of California and Nevada. His original data are preserved in vocabularies, manuscripts, boundary maps and a collection of approximately 1,100 baskets representing 157 separate tribes of 25 linguistic stocks—including a number of California tribes now extinct.

Dr. Merriam is credited with having named and described about 700 different genera, species and subspecies of animals; in addition, numerous other species have been named for him.

Further evidence of his boundless enthusiasm, tireless energy and breadth of interests is furnished by his set of journals spanning a period of about 70 years, and by the extent of his published writings numbering upwards of 500 titles plus numerous book reviews. The wide range in subject matter is illustrated by a few examples: The Birds of Connecticut (1877); Mammals of the Adirondacks (1884); Life Zones and Crop Zones of the United States (1898); Biological Survey of Mount Shasta (1899); Dawn of the World (Mewan Indian myths, 1910); Review of the Grizzly and Big Brown Bears of America (1917); Earliest Crossing of the Deserts of Utah and Nevada to Southern California—Route of Jedediah S. Smith in 1826 (1923), and Classification and Distribution of the Pit River Indian Tribes of California (1926).

When SCIENCE was reorganized in 1894 Dr. Merriam was a member of the editorial committee and continued to hold this position until his death after forty-seven years.

Dr. Merriam was a member of the National Academy of Sciences (since 1902), the Zoological Society of London and many other scientific societies. He was a past president of the American Ornithological Union, the American Society of Naturalists, the American Society of Mammalogists, the Anthropological Society of Washington, the Biological Society of Washington, the Linnaean Society of New York, the Yale Society of Natural History, and the Lewis County (N. Y) Medical Society. He enjoyed honorary membership in numerous foreign as well as American organizations.

He was the recipient of outstanding awards, including the Linnaean Society's Medal "for eminent work in mammalogy, ornithology and zoogeography," and the Roosevelt Medal "for distinguished work in biology."

His contagious enthusiasms were an inspiration to his colleagues, especially the younger naturalists. Along with his intense interest and driving energy in things scientific, he loved people. He was never too busy to help his friends in all walks of life, among whom he numbered hundreds of California Indians. The wide diversity of his friends and interests is further reflected by his intimate friendship with such people as Theodore Roosevelt, John Burroughs, John Muir, William Keith, Governor Pinchot, E. H. Harriman, General Funston, Samuel Pierpont Langley, Alexander Graham Bell, Gilbert Grosvenor, Admiral Peary, General Greeley, Rudyard Kipling, Sir Baden Powell, William Wallace Campbell and David Starr Jordan.

Dr. Merriam lived in Washington, D. C., during the winter for the greater part of his long and eventful life. His summer home was in the redwoods at Lagunitas, Calif., until 1939, when he made his home with his daughter in Berkeley.

Z. M. TALBOT
M. W. TALBOT

BERKELEY, CALIF.

RECENT DEATHS

FRANK COLLINS BAKER, curator emeritus of the Museum of Natural History of the University of Illinois, died on May 7, at the age of seventy-four years.

DR. CHARLES ROLLIN KEYES, consulting mining engineer, founder and editor of the *Pan-American Geologist Magazine,* died on May 18, at the age of seventy-seven years.

DR. WINFIELD CAREY SWEET, field director of the anti-malaria division of the Rockefeller Foundation in Bolivia, died on May 19, at the age of fifty years.

DR. MARCUS WARD LYON, JR., pathologist of the Clinic, South Bend, Ind., died on May 19, at the age of sixty-seven years.

Nature reports the death of Dr. B. M. Griffiths, formerly reader in botany and head of the department of botany in the University of Durham, on March 25, aged fifty-five years; of H. J. Hughes, formerly principal of the Muresk Agricultural College, Western Australia, on September 27, aged sixty-seven years; of F. J. Rae, director of the Melbourne Botanic Gardens and Government botanist for Victoria, on September 18; and of L. Wray, formerly director of the State Museums, Malaya, on March 14, aged eighty-nine years.

SCIENTIFIC EVENTS

THE POLISH INSTITUTE OF ARTS AND SCIENCES

It is reported in *The New York Times* that there has been established in New York City, with headquarters at 37 East 36th Street, a "Polish Institute of Arts and Sciences in America," composed of members of the original Polish Academy of Arts and Sciences who are now in this country. The official opening of the institute, which has been formed to "insure continuity of Polish cultural life which the Nazis seek to exterminate," took place on May 15. Professor B. Malinowski, of Yale University,[1] represented the new board of the institute. Professor O. Halecki, formerly dean of the Faculty of Arts in the University of Warsaw and now a visiting professor of history at Vassar College, has been named director of the institute. Professor R. Taubenschlag, formerly dean of the Faculty of Law in the University of Cracow, now associate professor in the New School for Social Research, will be the associate director. After the war the institute will be taken over by the Polish academy as a permanent institution promoting intellectual cooperation between America and Poland.

The audience, numbering about two hundred, was addressed by Jan Ciechanowski, Polish Ambassador to the United States. Others who spoke were Dr. W. G. Leland, director of the American Council of Learned Societies and president of the International Union of Academies; Professor Halvden Koht, formerly Norwegian Minister of Foreign Affairs; Paul Super, formerly director of the American YMCA in Poland; Professor Oscar Halecki, director, and Professor Raphael Taubenschlag, associate director.

Congratulatory messages were received from leaders of the Polish Government in exile, including President Wladyslew Raczkiewicz and Premier Wladyslaw Sikorski.

THE COLLEGE OF ENGINEERING OF NEW YORK UNIVERSITY

New York University, in cooperation with Adelphi College, has established a Day Division of its College of Engineering on the Garden City campus of Adelphi, and will open freshman classes for men and women on June 29.

The evening division of the College of Engineering, which was established at Adelphi in February, will be continued. The opening of the day division marks the inauguration of fully accredited engineering study for day students on Long Island, and under the plan of operation it will be the first coeducational engineering program in metropolitan New York.

The engineering classes will be conducted on the "war speed-up plan" already adopted by many engineering schools throughout the nation. Classes will begin on June 29 and run through the summer and fall terms of 1942, and through the spring and summer of 1943. After this period of 14 months, students will have completed the first two years of engineering study, and will be qualified to continue study as third-year students. At the same time, however, the 14 months of study will qualify students for many sub-professional positions with war industries, for civil service positions and for advanced study in other scientific fields. In a statement made by Dean Thorndike Saville this two-year "terminal" feature of the program has been introduced in recognition of the changing demands being made upon education.

> The urgent need for engineering specialists commissioned in the military services and for technically trained personnel in our war industries makes it desirable that in carrying out the vitally important task of educating more professional engineers, we do not overlook the value of the first two years of engineering as a means of training sub-professional engineering personnel for both war and peacetime service with industry.
>
> The administrators of both Adelphi College and New York University recognize both these national needs and hope to pioneer the field in meeting it with the establishment of the day division at Garden City, together with the operation of the evening division in engineering.

The plan provides that students will conclude their degree training at the University Heights center of the university, where junior and senior year instruction will be given, following the work at Garden City.

The need for highly specialized engineering laboratory study in the last two years makes it impossible to conduct these courses at Garden City. At University Heights the College of Engineering maintains five buildings devoted to technological and scientific laboratories, wind-tunnels, observatories, and administrative, aeronautical, chemical, civil, electrical, mechanical engineering and meteorology. The duplication of such facilities on Long Island would be impossible at this time.

THE ANNUAL REPORT OF THE BROOKLYN BOTANIC GARDEN

In the thirty-first annual report of the Brooklyn Botanic Garden, which has just appeared, the director, Dr. C. Stuart Gager, calls attention to the fact that the garden is within ten minutes' walk, or less, of the geographic center of Brooklyn. This accounts, in part, for the attendance, in 1941, of more than 1,753,000 persons. This large attendance, it is pointed out, is doubtless also due to the fact that each year the grounds become more and more beautiful. The attendance of classes from the schools of all boroughs was more than 116,000—the largest in the history of the garden.

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[1] Dr. Malinowski died on May 16.

The services which the garden renders to the city are many and varied. During 1941, more than 1,050,000 packets of seeds were distributed to school children for planting in school and home gardens, and the amount of vegetables raised in the "Children's Garden," a special area of about three quarters of an acre, is impressive. Each year, for the past three years, the crop there has included, for example, more than a ton of tomatoes. The "Children's Garden" is, however, conducted primarily as an educational activity, the crop of vegetables and flowers being considered of secondary importance.

The Brooklyn Garden administers one of the largest programs of public education of any botanic garden in the world. The entire staff of experts functions as a bureau of free public information and the number of requests for information increases yearly in number and variety.

The work of the garden falls under two heads, the increase of our knowledge of plant life—especially the practical knowledge of plant diseases and plant breeding and the dissemination of technical and popular information to the general public. A library of more than 40,000 volumes and pamphlets on all aspects of plant life is open daily to the public.

Of an operating budget for 1941 of $182,266, the city provided 51 per cent., and the trustees of the institute provided for the remainder out of private funds. During six of the past eight years the trustees have provided more than half the cost of maintenance and development.

The director calls attention to the urgent need of a suitable gate at the main entrance on Eastern Parkway and also to the need of an addition to the laboratory building to accommodate the rapidly expanding activities and the increasing collections of the library and herbarium and to provide for continually increasing educational demands.

THE NUTRITION FOUNDATION

DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology, chairman of the Board of Trustees of the Nutrition Foundation, announced on May 20 that the foundation had awarded grants of $125,000 for fundamental research in the science of nutrition.

George A. Sloan, president of the foundation, reported the election of the National Dairy Products Corporation as a founder member and the election of its president, L. A. Van Bomel, as a member of the board of trustees. Dr. Lloyd K. Riggs, of National Dairy Products, and Dr. J. T. Knowles, in charge of the Chicago Laboratory of Libby, McNeill and Libby, were appointed members of the food industries advisory committee.

Dr. Compton said that the board had considered a large group of applications with reference to three primary objectives, which the board wishes particularly to support under present conditions: (1) their contribution to our war effort; (2) their immediate advantage to public health; (3) their long-time advancement of the fundamental science of nutrition—the kind of exploratory research that will lay the foundation for better health and scientific guidance in the food industry of to-morrow. The grants were recommended to the board of trustees by Dr. Charles Glen King, scientific director, after appraisal by the scientific advisory committee of the foundation.

The companies whose contributions as founder members are making this program possible include, to date: American Can Company, Beech-Nut Packing Company, California Packing Company, Campbell Soup Company, The Coca-Cola Company, Continental Can Company, Inc., Corn Products Refining Company, General Foods Corporation, H. J. Heinz Company, Libby, McNeill and Libby, National Biscuit Company, National Dairy Products Corporation, Owens-Illinois Glass Company, The Quaker Oats Company, Standard Brands, Inc., Swift and Company and the United Fruit Company.

Dr. F. G. Boudreau, of the Milbank Memorial Fund, in addressing the members of the board of trustees, said:

> Progress in the science of nutrition has far outrun its application for the benefit of society. Much more has been done for animals than for human beings. Scientific feeding of live stock has paid high dividends. Scientific feeding of human beings would pay big dividends of a different kind. If all that we know about nutrition were applied to modern society, the result would be enormous improvement in public health, at least equal to that which resulted when the germ-theory of infectious disease was made the basis of public health and medical work.

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

THE summer meeting of the American Phytopathological Society will be held on June 25 and 26 at the Secor Hotel, Toledo, Ohio. Dr. H. C. Young, chief of the department of botany and plant pathology of the Ohio Agricultural Experiment Station at Wooster, is chairman of the "program and arrangements" committee for the meeting.

The program will be based largely on the activities of the War Emergency Committee of the American Phytopathological Society. The meeting will open at 10 A.M., on June 25, with reports and discussions on "The Role of Plant Pathologists in the War Program." Dr. E. C. Stakman, chief of the department of plant pathology and botany of the University of Minnesota and chairman of the war emergency committee of the society, will preside.

Dr. J. S. Horsfall will lead a round-table discussion on spray material and spray equipment priorities and substitute materials. Following this there will be a demonstration of techniques used in determining physical properties of dust mixtures and performance of dusting equipment.

The second day of the meeting, June 26, will include a discussion on the policies of plant pathology extension, research and teaching during the present emergency.

The final session on the afternoon of June 26 will deal with a summary of the program, policies and future activities of the society's war emergency committee.

AWARD OF THE PRIZE IN PURE CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY

THE prize of $1,000 in pure chemistry of the American Chemical Society has been awarded for 1942 to Dr. John Lawrence Oncley, associate in physical chemistry at the Harvard Medical School and instructor in chemistry at the Massachusetts Institute of Technology. Presentation of the award, given annually for "outstanding research in pure chemistry by a man or woman less than thirty-six years old," will take place at the one-hundred-fourth meeting of the society in Buffalo, N. Y., from September 7 to 11.

Dr. Oncley, who also is an instructor in chemistry at the Massachusetts Institute of Technology, was chosen in recognition of his contributions in the field of protein chemistry, in recognition of his investigations in the dielectric properties of gases, insulating oils, resins, rubbers and proteins and "for the development of radio-frequency bridge methods suitable for precise dielectric constant determinations with proteins." With the aid of these methods, it was said, he has completed the first entirely satisfactory study of the dielectric dispersion behavior of water-soluble proteins. "This work," according to the citation, "constitutes one of the really significant contributions of recent years to protein chemistry. These studies in turn have led to an interest in the molecular size and shape of protein molecules."

The American Chemical Society Prize, sponsored this year by Alpha Chi Sigma, national scientific fraternity, was founded in 1931 by the late A. C. Langmuir to encourage fundamental research by young chemists working in North America. Dr. Everett S. Wallis, of Princeton University, was chairman of the committee of award. Other members were Dr. George Scatchard, of the Massachusetts Institute of Technology, and Dr. Ralph L. Shriner, of Indiana University.

SCIENTIFIC NOTES AND NEWS

DR. FREDERICK P. KEPPEL, from 1923 to 1941 president of the Carnegie Corporation of New York, received from the American Association of Museums, at its annual meeting in Williamsburg on May 19, its award "for distinguished service rendered to the cause of museum education." This award, established in 1940 by Henry W. Kent, a former secretary of the Metropolitan Museum of Art, takes the form of a diploma. The presentation was made by Dr. Clark Wissler, of the American Museum of Natural History, president of the association.

AT the annual banquet of the Virginia chapter of Sigma Xi, held at Farmington on May 4, Dr. Walton C. Gregory, assistant professor of biology, Tennessee Polytechnic Institute, formerly a research fellow of the Blandy Experimental Farm, University of Virginia, was awarded the President and Visitors Research Prize in the natural sciences for his paper, entitled "Phylogenetic and Cytological Studies in the Ranunculaceae."

FRANKLIN AND MARSHALL COLLEGE, on the occasion of the installation as president on May 16 of Dr. Theodore A. Distler, formerly dean of Lafayette College, conferred the degree of doctor of science on Dr. Clarence E. McClung, professor emeritus of zoology of the University of Pennsylvania, and on Dr. William Henry Welker, head of the department of physical chemistry at the University of Illinois.

THE honorary doctorate of science was conferred on May 24 at the commencement exercises of the University of South Dakota on Dr. John H. Lawrence, '26, of the University of California, for "successful therapeutic use of radioactive phosphorus to produce remissions in leukemia in man and for his development of the medical applications of neutrons and artificially radioactive elements"; and on Lieutenant-Colonel Harry G. Armstrong, '28, in recognition of his work in the field of aviation medicine.

PURDUE UNIVERSITY conferred the honorary degree of doctor of agriculture, at the commencement exercises on May 3, on J. Clyde Marquis, adviser of the Office for Foreign Relations of the Bureau of Agricultural Economics, U. S. Department of Agriculture.

AT the spring congregation of the University of

British Columbia held on May 14, the honorary degree of doctor of laws was conferred upon Dr. C. McLean Fraser, professor emeritus of zoology. Dr. Fraser was head of the department of zoology for more than twenty years.

IN appreciation of his twenty-five years of service to the Ohio State University and on the occasion of his impending retirement as chairman of the department of zoology and entomology, the friends and associates of Dr. Raymond C. Osburn tendered him a testimonial dinner on the evening of May 11. A bound volume of letters from present and former students and colleagues was presented to him.

THE recipient this year of the Henry Russel Award of the University of Michigan is Dr. Richard H. Freyberg, assistant professor of medicine and director of the Rackham Arthritis Research Unit. The award, made in recognition of "distinguished achievement in medical research," is conferred annually by the university on a member of the faculty below the rank of associate professor.

PROFESSOR HARRY B. WALKER, head of the agricultural engineering division of the College of Agriculture at Davis of the University of California, has been elected president of the American Society of Agricultural Engineers. The annual meeting of the society will be held in Milwaukee from June 29 to July 1.

MEMBERS of the faculty of the University of California who will retire this year include Dr. William H. Wright, professor of astronomy and director of the Lick Observatory; Dr. Robert T. Legge, professor of hygiene; Dr. Robert E. Keys, associate professor of denture prosthesis; Dr. Frank W. Lynch, professor of obstetrics and gynecology; Dr. Howard L. Howard, professor of pomology, and Professor John W. Gilmore, professor of agronomy.

DR. ROBERT F. LOEB, since 1921 a member of the School of Medicine of Columbia University, has been appointed to the Lambert professorship of medicine. The chair was established this spring by the Columbia Board of Trustees in honor of the late Dr. Samuel Waldron Lambert, dean of the School of Medicine from 1904 to 1919. Dr. Lambert died on February 9.

PROFESSOR HAROLD W. BIBBER, of the department of electrical engineering at the Ohio State University, has been named professor of electrical engineering and administrative head of all engineering divisions at Union College, Schenectady, N. Y.

DR. M. DON CLAWSON has been appointed director of dental education at Meharry Medical College, Nashville, Tenn. The establishment of this position has been made possible by a grant from the Kellogg Foundation.

NEWLY elected officers of the Sigma Xi Chapter of the Ohio State University are: Professor John B. Brown, physiological chemistry, *President;* Professor Dwight M. DeLong, zoology and entomology, *Vice-president;* Professor Alfred B. Garrett, chemistry, *Secretary-Treasurer;* Professor Jorgen M. Birkeland, bacteriology, and Professor Lincoln LaPaz, mathematics, *Board of Electors.*

ROBERT M. SALTER, head of the Division of Soil and Fertilizer Investigations of the U. S. Department of Agriculture, has been appointed chief of the Bureau of Plant Industry, succeeding Dr. E. C. Auchter, who was recently appointed administrator of the Agricultural Research Administration. Dr. R. O. E. Davis, of the Bureau of Chemistry and Soils, has been designated acting head of the Division of Soil and Fertilizer Investigations.

THE American Ornithologists Union has elected John T. Zimmer, executive curator of birds of the American Museum of Natural History, to the post of editor of *The Auk,* the official organ of the society. He takes the place of Dr. Glover M. Allen, who died on February 14. Manuscripts intended for publication and books and papers intended for review should now be addressed to Mr. Zimmer at the American Museum of Natural History.

RUDYERD BOULTON, curator of birds at Field Museum, Chicago, has been granted indefinite leave of absence to accept an appointment to the staff of the Coordinator of Information at Washington.

DR. W. EDWARDS DEMING, formerly mathematical physicist with the Department of Agriculture and since 1939 mathematical adviser in the Bureau of the Census in charge of sampling designs, has recently been detailed for six months to the Inspection of Army Ordnance, in the capacity of adviser in sampling. At the end of the period he will return to the Bureau of the Census.

BRIGADIER-GENERAL ROBERT H. MILLS, U. S. Army, has recently been appointed chief of the Dental Corps. He occupies the position made vacant by the retirement of Brigadier-General Leigh Fairbank.

THE application by the council of the Zoological Society, London, to the Privy Council for leave to suspend temporarily the post of secretary—now held by Dr. Julian Huxley—has been declared invalid. The decision, which reverses a previous decision by the Privy Council, follows efforts by an informal committee of fellows of the society in challenging the council's action. Dr. Huxley has offered to serve as secretary "on leave" and without pay. Lord Horder has been nominated as president of the society in the place of Lord Onslow.

DR. MICHAEL HEIDELBERGER, of the College of Physicians and Surgeons, Columbia University, gave on May 8 and 9 at the University of Wisconsin, under the auspices of the Wisconsin Alumni Research Foundation, lectures on "Modern Concepts of Immunity and the Part of Chemistry in Their Development."

THE U. S. Civil Service Commission announces that the closing date for the receipt of applications for the position of junior chemist will be June 1. The commission will continue to receive applications from women for these positions until the needs of the service have been met. All applications must be filed with the Washington office. Complete information is contained in the original announcement.

ACCORDING to the *Journal* of the American Medical Association the W. K. Kellogg Foundation has offered to each one of nearly a hundred and fifty schools of medicine, dentistry, public health and nursing in the United States and Canada funds to be used for loans to students and scholarships. The foundation leaves the matter of scholarships in the hands of the school. It is planned to set up loan funds so that payments on loans will be made to the schools and thus provide a continuing or revolving fund. The scholarships will be granted on the basis of the scholastic ability, character and need of the applicant in comparison with other applicants. The only restriction suggested is that it should not be more than $500 to any one student in any one year.

THE sixty-eighth annual meeting of the American Neurological Association will be held at the Drake Hotel, Chicago, on June 4, 5 and 6, under the presidency of Dr. Lewis J. Pollock, Chicago.

THE American Society of Clinical Pathologists will hold its twenty-first annual meeting and its ninth seminar at the Hotel Benjamin Franklin, Philadelphia, from June 4 to 7, under the presidency of Dr. John L. Lattimore, of Topeka, Kans. His address will be entitled "The Pathologist as a Physician."

SPECTROSCOPY, of which the practical applications have become important for the war effort, will be the subject of a four-day conference that will be held at the University of Chicago from June 22 to 25. Subjects ranging from the spectra of comets to the molecules in synthetic rubber will be discussed in twelve sections. Of special interest during the present curtailment of dyes is the symposium to be held on June 24 on the spectra of dye molecules, in which will be reported the latest developments in dyemaking. Those who will take part in the conference include James Frank, Nobel laureate, professor of physical chemistry at the University of Chicago; W. F. Meggers, the National Bureau of Standards; A. McKellar, Dominion Observatory, Victoria, British Columbia; W. E. Williams, the University of London; F. L. Whipple, Harvard Observatory, and P. Pringsheim, the University of Chicago.

A CHAPTER of the Society of the Sigma Xi was established at the Illinois Institute of Technology on March 25. The national president, Dr. R. A. Gortner, and the national secretary, Dr. G. A. Baitsell, took part in the ceremonies, attended by eighty local members and delegates from seven other colleges and universities. Dr. Rufus Oldenburger, associate professor of mathematics; Dr. David Boder, professor of psychology; Dr. George Ziegler, physicist, and Dr. Hugh McDonald were elected *President, Vice-president, Secretary* and *Treasurer,* respectively. Dr. H. A. Bethe, of Cornell University, delivered an address entitled "Energy Production in Stars." At a subsequent meeting eleven members and sixteen associates were elected to the local chapter, the following professors being among those elected to membership: Dr. Hans Reissner, Dr. Vasili Komarewsky, Dr. Michael Sadowsky and Dr. Myril Reed.

IT is reported that the War Department is planning to take over on August 1 the Battle Creek Sanitarium for use as a general base hospital. Its estimated value is $12,000,000. Dr. John Harvey Kellogg, who was medical director of the sanitarium for many years, is now a member of the board entrusted with control in the reorganization of 1938, after financial difficulties. The Army, it is said, will assume payment of a $1,271,500 mortgage, $18,300 in unpaid taxes and other liens, amounting in all to $2,250,000.

DISCUSSION

THE GEOLOGICAL HISTORY OF THE BERMUDAS

THE Bermudas being oceanic islands, any evidence as to their geological history is of considerable value. It is known from a single deep boring[1] and from two seismic soundings[2] that there is a volcanic core now lying at a depth of about 250 feet below sea level. Sayles[3] considers that this was cut down to its present level by wave action during tertiary times and not during the period of much lower sea level of pleistocene times. Finally from the evidence of submerged caves (Sayles, *loc. cit.*) and from peat bogs[4] it is clear that sea level in Bermuda must at one time have stood at least 60 to 100 feet lower than at present, and possibly considerably more, while from raised beaches (Sayles, *loc. cit.*) it appears to have stood at one time at least 25 feet higher than at present.

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[1] L. V. Pirsson, *Am. Jour. Sci.*, 38: 189–206, 331–334, 1914.

[2] G. P. Woolard and M. Ewing, *Nature*, 143: 898, May 27, 1939.

[3] R. W. Sayles, *Proc. Am. Acad.*, 66: 11, 380–467, 1931.

Practically all the rocks now above sea level in Bermuda are eolianites formed, together with alternating soil layers, during the glacial and interglacial periods. There is a small amount of marine limestone which, from its coarse particle size and the nature of its fossils, seems to have been consolidated from either beach sand or a very shallow water deposit.

During dredging operations for the new American air base at Bermuda, large amounts of rock have been brought up from 30 to 50 feet below sea level in Castle Harbor. These appear to fall into the following categories: deepest of all is a reddish-brown clay, quite unlike anything previously known from Bermuda, and Dr. E. S. Larsen, who has examined it, states that it probably was derived from the weathering of volcanic rocks. It contains no fossils except foraminifera, and from its very fine texture would seem to have been deposited in fairly deep water, probably after reworking. Above this is calcareous rock, also of extremely fine texture, and characterized by the very abundant coral *Cladocera arbuscula* Le Seur, many other fossils also being present. Above this again is a rock of similar fine texture but characterized by the coral *Occulina,* which, while abundant in shallow water, extends deeper than most of the typical reef corals. Reef corals such as *Meandra, Montastraea, Porites* and *Siderastrea* are rare or absent in these two rocks.

Above these fine texture rocks is a much coarser calcareous sandstone such as might be formed from the deposits in the shallow areas inside the present reefs, and containing most of the modern reef corals, but not *Cladocera.* Finally above these is unconsolidated sand, whose fauna resembles in most respects that of the present day. With the exception of small local patches of peat, which indicate temporary mangrove swamp conditions, the scarcity of purely littoral species is striking.

The above is a summary of the observations which we have made to date, and which it is hoped will be considerably expanded when Dr. Frederick Foreman, who is working on the minerals from these formations, completes his investigations. The sequence of rocks and their fauna suggests a progression from fairly deep to shallow water conditions. As this range of probably several hundred feet is represented by only 30 to 50 feet of deposits, the change was presumably due to either a rise of the land or a drop in sea level. Since these deposits, except for the recent loose sand, are all below the land eolianites, they are presumably preglacial. Also, in glacial times the sea level was lower, and not higher than at present. According to Daly[5] in late Tertiary times sea level was probably 85 to 170 feet higher than it is now, and this would be quite sufficient to account for the observed sequence of fauna in the rocks.

HILARY B. MOORE

BIOLOGICAL STATION,
BERMUDA

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[4] A. S. Knox, *Jour. Geol.*, 48: 7, 767–780, 1940.

[5] R. A. Daly, *Bull. Geol. Soc. Amer.*, 40: 721–734, 1929.

A GROUND SLOTH IN ALASKA[1]

CHILDS FRICK, honorary curator of the American Museum of Natural History, has kindly permitted me to examine and report upon a phalangeal element of an extinct megalonychid ground sloth from the Quaternary of Alaska. The specimen, No. F.A.M. 30844, a first or proximal phalanx, possibly of the fourth digit, manus, is larger than the corresponding bone in *Nothrotherium* and represents apparently a species of *Megalonyx.* Curiously enough, it is the only ground sloth material thus far recorded from the frozen muck of Alaska. This is all the more remarkable in view of the fact that during thirteen seasons of work since 1929 the Childs Frick Expeditions in cooperation with the University of Alaska have conducted intensive paleontological explorations in this northern region. The present specimen, found by Otto Wm. Geist during the field season of 1941, adds another large mammal to the extinct pre-tundra fauna known from Alaska.

The site of discovery of the *Megalonyx* phalanx occurs on Cripple Creek, approximately fifteen miles southwest of Fairbanks. Associated fossil mammals from this region[2] include the woolly mammoth (*Mammonteus primigenius*), mastodon (*Mammut americanum*), horse (*Equus alaskae*), bison (*Bison crassicornis*), ovibovids (*Symbos tyrrelli* and *Boötherium sargenti*), camel (*Camelops*), saiga antelope (*Saiga ricei*), as well as large carnivores like the great cat (*Panthera atrox*), short-face bear (*Arctotherium yukonensis*) and dire wolf (*Aenocyon dirus*).

The genus *Megalonyx* is associated with the Pleistocene forest faunas of the more southerly regions of North America. Remains of this mammal were first described by Thomas Jefferson from a limestone cave in western Virginia. Since then these ground sloths have been encountered at a number of Pleistocene localities in North America from southern Nuevo

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[1] Contribution No. 335, California Institute of Technology.

[2] C. Frick, *Nat. Hist.*, 30: 69–80, 1930. Illustrated.

Leon, Mexico, to eastern Washington. The occurrence in Alaska extends the geographic range of *Megalonyx* considerably to the north of its previously known distribution.

CHESTER STOCK

A VESTIGE OF BABYLONIAN INFLUENCE IN THERMOMETRY

IT is well known that our common measures of time and angles—in terms of degrees, hours, minutes and seconds—are derived from the ancient Sumerians of the Mesopotamian valley who made use of a sexagesimal system of numeration. It is less manifest, but nevertheless also true, that the common measure of temperature in terms of degrees Fahrenheit is likewise a product of Sumerian or Babylonian influence.

Galileo's application of the telescope to astronomical observation had an immediate and profound effect on science. On the other hand, his invention of the thermometer apparently failed at first to impress either Galileo himself or his successors in science. This fact undoubtedly is to be ascribed to the lack at that time of a standard and universally reproducible scale. The Florentine academicians and their associates subdivided the interval between the extreme cold of winter and the greatest heat of summer into an arbitrary number of equal parts—sometimes fifty; or again one or more hundreds; or occasionally 360, to correspond to the Babylonian "degree" measure of the circle. Such thermometric scales competed during the seventeenth century with others, notably those based on the medieval division into eight degrees of heat and cold. During this period there was no one scale which conventionally was preferred either as to fixed points or as to subdivisions.

Very early in the eighteenth century Roemer carried out investigations in thermometry in which he chose the boiling point of water as his higher fiducial point and the temperature of a mixture of ice and salt as the point of extreme cold. It then remained for him to subdivide the interval between these points in some suitable manner. Numerous suggestions already had been made by others, but Roemer's choice in all probability was determined by the fact that he was interested primarily in astronomy. In this field Babylonian tradition, continued in Greek, Arabic and Latin treatises, had dictated the sexagesimal subdivision. In view of this situation it seems natural that Roemer should have adopted sixty divisions for his thermometer. (Indeed, in this respect there was precedent for his action; almost a century earlier Telioux, a Roman engineer, had superimposed the sexagesimal subdivision upon a primary scale of eight degrees.) Roemer consequently designated his lowest and highest temperatures as 0 and 60, respectively. He noted that on this basis water froze at about 7½ or 8 degrees, and that normal body temperature was approximately 22½ degrees; and Roemer checked the calibration of his thermometers through the use of these intermediate or secondary fixed points.

The scale of Roemer never secured wide recognition, but it formed the basis of another one which did. Fahrenheit in 1708 visited Copenhagen and there found Roemer calibrating thermometers. As a result he was led to adopt the same fundamental principles in his own work, with but minor changes. He chose the same minimum point as Roemer; but inasmuch as Fahrenheit was a maker of scientific instruments whose attention had been directed to thermometry through meteorology, he preferred to take body temperature as his upper limit. Then too he found Roemer's sexagesimal subdivision too gross, so that Fahrenheit subdivided each of its sixty subdivisions into four parts. The freezing point of water thus became 4 × 8 or 32, and body temperature 4 × 22½ or 90. Later he changed the scale slightly so that normal body temperature should correspond to 96 instead of 90. On this modified scale he found incidentally that water boiled at 212 rather than 240. "Fahrenheit" thermometers to-day are calibrated more accurately on the basis of the freezing and boiling points of water, so that Fahrenheit's upper fixed point, body temperature, is now only an incidental intermediate point, at 98.6. Such successive modifications have served to conceal the sexagesimal subdivision in which our common or Fahrenheit measure of temperature originated. A recognition of this Babylonian basis will make clear that the figures 32 and 212 are not simply the result of an eccentric or capricious arbitrariness but represent vestiges of an ancient scale of numeration. However, the decimal system (represented by the Centigrade thermometer) appears to be in a fairer way to efface this remnant of Babylonian influence in thermometry than to displace it in the older fields of angle and time measure.

CARL B. BOYER

BROOKLYN COLLEGE

IMMUNITY AND RESISTANCE

IT is my earnest hope that Dr. Rivers's statement,[1] "Immunity is resistance to infection or injury . . . ," will help to arouse extremely high resistance to the synonymous use of the words "immunity" and "resistance." They have been used interchangeably by other writers, especially in medical publications, but that does not prove that it is desirable or proper usage. Each can serve us most satisfactorily if used to convey the idea indicated by its derivation. The word "immune" means free or exempt from any certain thing. The word "resistant" correctly used means that the object, either living or dead, offers appreciable opposition to whatever is endeavoring to attack or to overcome *it*, and the amount of such opposition may be slight or great. "Resistance" properly does not and should not convey the idea of complete exemption or freedom from any infectious agent or from disease in man, animals or plants. An organism may be immune from disease in the sense of distinct injury and not be immune from the infectious agent. It is true that an organism may be immune or resistant only under certain conditions, and we have to recognize the factor of *biological variations*. The two words "immunity" and "resistance" are not legitimately commutable and should not be used synonymously. The word resistance is too useful in its original meaning for indicating that the force (virus in this case) encounters a clearly evident degree of opposition on the part of the host either to the process of infection or to the injurious effects which might be expected to follow such infection. The word "immune" should be reserved for those cases in which there is no evidence of disease or in which the infectious agent is unable to establish itself in the host.

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[1] Thomas M. Rivers, SCIENCE, 95: 107, 1942.

N. J. Giddings

Bureau of Plant Industry,
U. S. Department of Agriculture,
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VITAMIN A FOR COLOR-BLINDNESS

Publicity given in the press to our report to the Southern Society for Philosophy and Psychology has resulted in a flood of inquiries which make it desirable to summarize our results for the benefit of the scientific public, omitting the study by the junior author (now in process of publication) which led up to the practical work.

(1) We have found it desirable to administer Vitamin A in doses of 25,000 units. Most cases are cleared up in from three to eight weeks by one dose per day.

(2) Administering 50,000 units per day seems to accelerate the cure; but upset some digestive tracts. We suggest to inquirers that they take one dose (25,000 units) after breakfast, and a second dose after dinner. If digestive trouble results, to reduce to one dose per day.

(3) By "clearing up" a case, we mean enabling the patient to pass a standard color-vision test on which he has previously failed. The tests involved are chiefly of the chart type (Stilling, Ishahara, etc.), administered in the naval and air services. Performance on worsted tests, however, are likewise made normal.

(4) We do not know how "permanent" the cures are. That is a matter for further research.

(5) We find, so far, no clear correlation between color-blindness and diet; nor have we definite evidence as to the effects of past infectious disorders.

(6) Color-blindness, of the so-called "red-blind" type, obviously is not the simple "sex-linked Mendelian character" which popular theories have assumed it to be. Apparently, the causes of the condition are complex.

(7) Persons who, when tested, are found to be color-blind, but who have not known it, may now reasonably be suspected of not having been color-blind very long.

Knight Dunlap
Robert D. Loken

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at Los Angeles

SCIENTIFIC BOOKS

DIMENSION

Dimension Theory. By Witold Hurewicz and Henry Wallman. 165 pp. Princeton University Press. 1941. $3.00.

A description of a geometrical object has to include a list of properties concerning curvature, convexity, connectedness, etc. First in any such list, however, would have to be a specification whether the object is a solid, a surface or a curve.

If the object is simple, then this basic question concerning its geometric nature can easily be answered. The dimension of a simple object can, for instance, be characterized as the least number of parameters needed to describe its points.[1]

Up to the seventies of the last century all objects of geometry were so simple that their points could be described by parameters and equations. However, with the tremendous extension of the domain of geometry due to Cantor's theory of point sets innumerable entities were introduced which are far beyond the reach of these simple methods. They are defined by joining and intersecting infinitely many cubes and squares, by various successive approximations and limit processes, some even by processes involving infinitely many unspecified choices. Naturally, to most geometrical objects of this enormous domain the classical characterization of dimension in terms of numbers of parameters is completely inapplicable.

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[1] *E.g.*, one parameter, t, is sufficient to describe the points of the circle $x = \cos t$, $y = \sin t$. Two parameters, u and v, are needed for the description of the sphere in the usual representation $x = \sin u \cos v$, $y = \sin u \sin v$, $z = \cos u$.

Yet we are as interested in the dimension of the more complex entities as we are in that of simple figures, and we unhesitatingly classify many of them as solids, surfaces or curves.

To formulate the intuitive difference between these three classes one can devise a simple experiment whose outcome depends upon the dimension of the object to which it is applied. We cut out from the object a piece surrounding a given point. If the object is a solid we need a saw to accomplish this, and the cutting is along surfaces. If the object is a surface a pair of scissors suffices, and the cuts are along curves. If we deal with a curve we may use a pair of pliers and have to pinch the object in dispersed points. Finally, in a dispersed object no tool is required to perform our experiment, since nothing needs to be dissected. This characterization of dimension leads from n-dimensional to $(n-1)$-dimensional objects. It ends with dispersed sets, naturally called 0-dimensional, and, beyond these, with "nothing," in set theory called the "vacuous set." It is therefore convenient to consider the latter as -1-dimensional. The rigorous definition of dimension, starting with the -1-dimensional vacuum, reads as follows: A space is at most $(n-1)$-dimensional if each point is contained in arbitrarily small neighborhoods with at most $(n-1)$-dimensional boundaries. It is n-dimensional if it is at most n-dimensional without being at most $(n-1)$-dimensional.

During the last two decades an extensive theory has been derived from this definition. The need of an up-to-date exposition of dimension theory has been urgent for some years. Hardly any one is as well qualified to write such a summary as is Witold Hurewicz, who from the time of his Vienna doctoral thesis in 1925 has brilliantly contributed to the development of this branch of modern geometry. His collaborator, Henry Wallman, is noted for recent work in topology.

Their exposition, which is unsurpassed in elegance, covers not only most of the important results of dimension theory, in particular those of recent origin, but also discusses related topological questions. Concise definitions of even the most primitive concepts of topology are to be found in the text or in the alphabetical index at the end. The book can therefore be recommended as an excellent introduction into modern topology.

An introductory chapter outlines the development of the dimension problem and various approaches to its solution. The next chapters develop some of the results obtained before 1928. In several cases (in particular, with regard to the so-called local dimension) the proofs yield stronger statements than the authors actually formulate in their theorems.

Chapter IV contains a new proof of the fact that the n-dimensional space of analytic geometry is n-dimensional in the sense of dimension theory. The last section of this chapter is devoted to spaces of infinitely many dimensions. In the opinion of the reviewer this is a branch of dimension theory promising many important applications in the future since, so far, in the theory of functional spaces and operators dimension theory has received less attention than it deserves.

On the other hand, dimension theory has applied with great advantage functional spaces, as is shown in Chapter V, containing the theorem that each n-dimensional space can be topologically embedded into (*i.e.*, is homeomorphic with a subset of) the $(2n+1)$-dimensional Euclidean space. For instance, each curve (even a curve contained in a space of infinitely many dimensions) can be topologically embedded into our 3-dimensional space, each surface into the 5-dimensional Euclidean space, etc. While it is easy to construct a curve which can not be embedded into the plane, it was difficult to prove the existence of a surface which can not be embedded into the 4-dimensional space, and, in general, of an n-dimensional complex which can not be topologically embedded into the $2n$-dimensional space. That A. Flores' solution of this problem is only mentioned and not reproduced in "Dimension Theory" will be regretted by many a reader of the book, and the same may be said about Pontrjagin's example of two 2-dimensional spaces with a 3-dimensional product. The elaboration of these important examples would have been worth a few additional pages.

Chapter VI discusses mappings of spaces on the n-dimensional sphere and ends with very simple proofs of such classical results as the Jordan theorem for the n-dimensional space generalizing the fact that the 2-dimensional space (*i.e.*, the plane) is disconnected by the omission of the topological image of a 1-dimensional sphere (*i.e.*, a circle). After a short discussion of dimension and measure, a last chapter contains an excellent introduction into homology theory relating topology (and dimension theory) to algebra.

An appendix explains why the authors have restricted the development of dimension theory to separable metric spaces. Extended to still more general spaces the concept of dimension mentioned in this review has some rather strange properties, while the extension of similar definitions, as Wallman recently discovered, leads to almost unbelievable paradoxes.

We speak of a function of sets in a space if with each subset of the space (or at least with each subset of a certain kind) a number is associated. Dimension is such a function of sets in a Euclidean space, measure is another one. The book ends with the question as to which properties characterize dimension among all possible functions of sets. It is to be hoped that this remark may, as many other remarks of the book undoubtedly will, stimulate further research in this difficult but really fundamental field of modern geometry.

KARL MENGER

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CHEMISTRY

Principles of General Chemistry. By STUART R. BRINKLEY. Third edition. x + 703 pp. New York: Macmillan Company. August, 1941. $4.00.

IN comparison with the second edition (1933) of this well-known college text, this new one offers some changes in the order of the topics in the introductory chapters, to render more effective the scientific deductions which follow. In line with modern developments, increasing use is made of physico-chemical concepts in theoretical discussions and in their application to practical industrial processes. A chapter has been added dealing with the nucleus of the atom, artificial radioactivity, transmutation of the elements and nuclear fission. In other respects, also, the work has been brought up to date.

General Chemistry. By HARRY N. HOLMES. Fourth edition. viii + 720 pp. New York: Macmillan Company. June, 1941. $3.75.

OF the many books on general chemistry which have appeared during recent years, few have presented the subject with the charm and allure which characterize this new edition of Dr. Holmes's justly popular text. Simple, straightforward and clear, in its narration and discussions, it is not only easy but also exceptionally interesting reading. The innumerable ways in which chemistry concerns our lives, our industries and our civilization are illustrated by arresting examples. Any student who digests what this book contains will have acquired, in addition to his chemical knowledge, a surprising store of useful information and a pretty good general education.

The new material added to the third edition (1936) concerns the conception of electrovalence, covalence and coordinate covalence, nuclear chemistry, radiation chemistry, colloid chemistry, uranium fission, new achievements with giant cyclotrons, chemotherapeutic advances, etc., as well as the later developments in manufacturing chemistry (synthetic rubber, Nylon, etc.). Each chapter concludes with "Exercises" and "References."

MARSTON T. BOGERT

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SOCIETIES AND MEETINGS

THE SECOND LAS CRUCES MEETING OF THE SOUTHWESTERN DIVISION

THE twenty-second annual meeting of the Southwestern Division of the American Association for the Advancement of Science and eight associated societies and institutions was held in Las Cruces, New Mexico, during the week of April 27. The associated societies were the American Association of University Professors, Clearing House for Southwestern Museums, El Paso Archaeological Society, Mathematical Association of America, New Mexico Academy of Science, Society for American Archaeology, State College Biological Society and White Sands National Monument.

Although there were those who felt the meeting should not be held because of the war emergency, the paid registration of ninety seems to have thoroughly proved the wisdom of carrying on. One objection to holding meetings at the present time is that most persons drive and now the rubber situation will keep them home. In answer to this, it is worth noting that about 40 per cent. of the papers presented were the product of teachers and research workers residing at the host institution. This situation is often overlooked, but during the months to come we are going to realize more and more the importance of taking scientific meetings to men and women who for one reason or another rarely have the opportunity of going to a meeting away from home. What is equally important is the necessity of vacations even during war times, and these can frequently be combined with business.

The New Mexico State College of Agriculture and Mechanic Arts, serving as host institution, was aided by the New Mexico State College Experiment Station, the U. S. Bureau of Plant Industry and the White Sands National Monument. The college was founded in 1889 when travel was by way of the "Jornada del Muerto" or by the Santa Fe railroad. It is located at State College, which lies at one corner of a triangle, having sides of three to four miles, the other corners being occupied by Las Cruces and Mesilla. To the east lie the Organ Mountains with one of the most beautifully serrated skylines to be found in North America. The country is rich in tradition and folk lore going back to the days when it was still beyond the United States and was a part of Old Mexico. The museum at Old Mesilla, a village of adobe buildings, is filled with historic articles associated with both the peaceful settlers and the bandits of old, such as Billy the Kid.

A large measure of the success of the meeting was due to the carefully selected local committee, headed by Professor C. W. Botkin. The meeting was officially opened by a welcoming address by J. W. Branson, acting president of the college, to which Dr. Wm. M. Craig, president of the division, responded for the association.

After-dinner addresses were given by Drs. John D. Clark and Donald D. Brand, of the University of New Mexico at Albuquerque, on "Conservation Since 1933" and "Observations on Certain South American Economies," respectively. The thirteenth annual John Wesley Powell Memorial Lecture was given in the Branigan Memorial Library in Las Cruces on Tuesday evening by Mr. Howard W. Blakeslee, joint Pulitzer Prize winner in journalism in 1937. Mr. Blakeslee, who is the science editor of the Associated Press, spoke on "Science Moves Ahead."

Most of the eighty-seven papers whose titles were printed in the program were delivered by the authors in person, but more urgent government assignments kept some from coming to Las Cruces. These titles showed the mark of war as well as of peace, ranging from "The Anatomy of Guayule," by Ernst Artschwager, of the Bureau of Plant Industry of the U. S. Department of Agriculture, to "A Preliminary Examination of Some Proposals for World Reconstruction," by Professor P. M. Baldwin, of the New Mexico State College. These papers were delivered in the four rather general sections of Biological, Mathematical, Physical and Social Sciences.

Both the palate and the artistic sense were given a rare treat on the occasion of the Wednesday noon Spanish luncheon at "La Posta" in Old Mesilla. "La Posta" is operated by the Griggs family, descendants of the pioneers, in the original adobe building made famous by its rare tradition and modern excellence. After the luncheon, Dr. Fabian Garcia, director of the Experiment Station and a native of Chihuahua, Mexico, told many interesting stories of the early days in the village, including many of his own personal experiences which were told partly in Spanish, partly in English.

Tuesday afternoon was devoted to an excursion to the "White Sands National Monument," fifty-four miles northeast of Las Cruces near Alamogordo, New Mexico. This largest of the rare gypsum deserts covers more than 600 square miles of snowdrift-like "sand" dunes consisting of sparkling white dehydrated calcium sulphate. Some of these dunes are over fifty feet high and are constantly being moved by the prevailing winds. Descriptive talks were given on the grounds by Dr. W. B. McDougall, of the Park Service, on the "History and Development of White Sands National Monument"; by Dr. S. B. Talmage, of the Department of Geology of the New Mexico School of Mines at Socorro, on "Gypsum on Tour"; and by Dr. F. W. Emerson, of the Department of Biology of the New Mexico Highlands University at Las Vegas, on "Some Biological Relations of the White Sands." After spending more than an hour climbing upon the dunes and sliding down the steep faces, the scientists with wives and children were thoroughly ready to do justice to the "Chuck Wagon Supper" which was prepared on the grounds.

On Wednesday evening Dr. Wm. M. Craig, retiring president, delivered his address on "The Rôle of Spectrography in National Defense," in the auditorium in Hadley Hall.

For those who stayed over on Thursday there was a choice of visiting the Jornada Experimental Ranges of the New Mexico College of Agriculture and Mechanic Arts and of the U. S. Forest Service, a trip to the Organ Mountains to study the native flora and fauna, the Conkling Cave and Bishop's Cap Mountain, or to El Paso, Texas, and Juarez, Mexico.

At the annual business meeting, Dr. H. P. Mera, of the Laboratory of Anthropology at Santa Fe, New Mexico, was chosen president, and Professor F. H. Douglas, of the Denver Art Museum, was chosen vice-president. New members of the executive council chosen were Dr. Wm. M. Craig and Dr. E. W. Haury.

Section officers elected for the coming year were:

Biological Sciences:
- Dr. E. F. Castetter, *Chairman*, University of New Mexico.
- Dr. Edna Johnson, *Secretary*, University of Colorado.

Mathematical Sciences:
- Dr. Emmett Hazlewood, *Chairman*, Texas Technological College.
- Dr. P. M. Swingle, *Vice-Chairman*, New Mexico State College.
- Dr. H. D. Larsen, *Secretary*, University of New Mexico.

Physical Sciences:
- Dr. O. B. Muench, *Chairman*, New Mexico Highlands University.
- Dr. Parry Reiche, *Secretary*, Albuquerque, New Mexico.

Social Sciences:
- Professor F. H. Douglas, *Chairman*, Denver Art Museum.
- Professor W. W. Postlethwaite, *Secretary*, Colorado College.

The 1943 meeting will be held in Colorado Springs, Colorado, and the 1944 meeting in Phoenix, Arizona. An invitation to meet in Las Vegas in 1945 was received, but action was postponed.

FRANK E. E. GERMANN,
Executive Secretary-Treasurer
UNIVERSITY OF COLORADO

REPORTS

THE AMERICAN MUSEUM OF NATURAL HISTORY[1]

A GRATIFYING increase in visitor attendance and museum membership, the completion of many important exhibits, a splendid output of scientific publications and many additions to museum collections make 1941 a year of important progress. Merely to glance at the contributions of the scientific, educational and administrative departments to this annual report is to appreciate the extent and immense value of the work carried on in this institution.

Early in the year the trustees, through a Survey Committtee, commenced an investigation into the museum, and this work will be carried on by the Plan and Scope Committee of the scientific staff. Important changes in trustee and staff organization are being made to enable the museum not only to move towards a definite plan of development but to operate more efficiently within its limited budget. In these changes one salient fact is recognized, that the scientific staff gives the museum its importance not only in the fields of natural science but in general public recognition. The great collections, the exhibits, the educational work in schools and colleges all alike must be based upon the highest scientific standard and knowledge, which can come only from the men and women who compose the scientific staff. Better to enable this group to work, freely to express itself, and to create, develop and carry out great museum plans is the important aim of the trustees. Our scientists fully realize that the "ivory tower" aspect of science is a thing of the past, and that the whole work and development of our institution must be integrated with the life of the community and the nation.

This nation is dedicated to the principle of enlightening its citizens—free minds, not closed minds—free search for knowledge, not propagandized thought. Our great museums are repositories for knowledge; they not only germinate free thought but minister to man's insatiable desire to know more about himself and the world. Museums are one of the important social agencies wherein man develops his spiritual outlook, and in the total war in which this country is engaged the spirit of a free people must be nourished.

Concerning the war effort it is interesting to learn that the scientific staff is uniquely qualified to provide information for various governmental agencies and invaluable data for our military and naval forces. Thus, the museum will provide vital information on parasites prevalent in war; the importance of insects in war; rodent disease carriers; the distribution and habits of, and safeguards against, poisonous snakes; illustrations of tests used to determine the fitness of soldiers; the war terrain of various parts of the globe which have been studied and visited in person by our scientists and explorers; descriptions of inhabitants and tribal customs, of flora and fauna; charts of ocean currents in the Caribbean and other waters, and other topics. Of aid to pilots and ocean navigators is our Hayden Planetarium course in celestial navigation. Research conducted by the museum in past years provides knowledge of marine products useful in war time as well as marine forms dangerous to shipping. Knowledge of nature's incomparable camouflage system is useful.

The department of education, in addition to greatly extending its service within the museum, is planning the creation of portable school museums to be circulated in the New York area, this work to be done in cooperation with other museums receiving city aid; establishment of "Hobby and Craft Development Centers"; establishment of "Community Museums"; integration of museum materials to illustrate various aspects of war areas; and organization of a radio series dealing with the relation of natural science to war.

Above all, the museum is a house of refuge from the stress of wartime existence and as such will continue to provide relaxation, enjoyment and inspiration for an ever increasing number of people.

On behalf of President F. Trubee Davison, who is on active war service, and the Board of Trustees, I wish to express our deepest appreciation to the many hundreds of people who have given generously of their time, effort and means to carry forward the work of the institution.

A. PERRY OSBORN,
First Vice-president

SPECIAL ARTICLES

THE RELATION BETWEEN NUCLEIC ACID AND GROWTH*

RECENT work employing isotopic techniques emphasizes that most tissue constituents undergo continuous synthesis and degradation. In view of the great biological stability of chromosomes in contrast to the variability of most other visible cell constituents, it is of interest to know whether their components show relatively greater chemical stability as well.

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[1] Annual report of the president to the trustees of the American Museum of Natural History and to the Municipal Authorities of the City of New York.

* This is reprint No. 53 of the Cancer Commission of Harvard University.

Several investigations have recently been made on the turnover of nucleoproteins and nucleic acids in normal and malignant tissues, using radioactive phosphorus as a tracer. Hahn and Hevesy[1] found a slow but appreciable turnover of nucleic acid phosphorus in all rabbit tissues studied. In the case of normal rabbit liver two thirds of the nucleic acid molecules were unchanged after fifty days, whereas all other forms of organic phosphorus were entirely renewed in the course of a few days. Marshak,[2] in experiments with isolated nuclei, found a rapid turnover of phosphorus in the protein fraction of lymphoma and of resting liver, indicating to him a rapid synthesis and breakdown of nucleic acids in the nuclei of these tissues. The accumulation of P^{32} in lymphoma nuclei and the increment over resting liver observed in regenerating liver, he ascribes to mitotic activity. Tuttle, Erf and Lawrence[3] noted that the turnover rate of P^{32} in the "nucleoprotein fraction" of leukemic infiltrated mouse tissues was three to four times higher than in corresponding normal mouse tissues.

In the present experiments, 63 pure strain Slonaker rats weighing between 150 and 200 grams were injected intraperitoneally with neutral sodium phosphate containing 15 to 30 microcuries of radioactive phosphorus (P^{32}). Thirty of these animals were subjected to partial hepatectomy 24 hours before P^{32} injection. This interval was chosen because we have shown[4] that it takes this long for mitotic activity to begin. The rats were exsanguinated under ether anesthesia at six intervals between 6 and 72 hours after injection. For each determination the livers of three rats were pooled and ground in ice-cold saline. A small aliquot of the resulting liver protein solution was precipitated with cold 8 per cent. trichloracetic acid. This precipitate, subsequently freed of phospholipids,[5] we have called "total protein," and this corresponds to the "nucleoprotein" of Tuttle *et al.*,[3] and Kohman and Rusch.[6] From an aliquot of the trichloracetic acid filtrate, inorganic phosphorus was precipitated with an ammoniacal solution of magnesium and ammonium nitrates. Nucleic acid was isolated from the rest of the original liver protein solution by one of two procedures, Levene's[7] and Hammarsten's,[8] which was adapted to liver by omitting the calcium chloride precipitation. The protein remaining after the latter separation of nucleic acids is then freed of phospholipids[5] and termed "protein residue." All these fractions have been analyzed for P^{31} and P^{32}; results have been expressed as specific activities (P^{32}/P^{31}) of each fraction relative to the specific activity of the inorganic fraction of the same tissue.

The results of our experiments on resting liver (Fig. 1) show that the turnover of phosphorus in the nucleic acid fraction is very much less than in any other phosphorus-containing fraction. The "protein residue" has a rapid turnover of phosphorus, distinguishable from the slower rate of nucleic acid and from the faster rate of phospholipid. The "total protein," which contains both nucleic acid and "protein residue," has a rate of turnover intermediate between the two, and examination of Fig. 1 will show that only about half the "total protein" phosphorus is nucleic acid phosphorus. Other writers have assumed that nearly all the phosphorus of the trichloracetic acid precipitate (when free of phospholipids) is contained in the nucleic acids.[3,6]

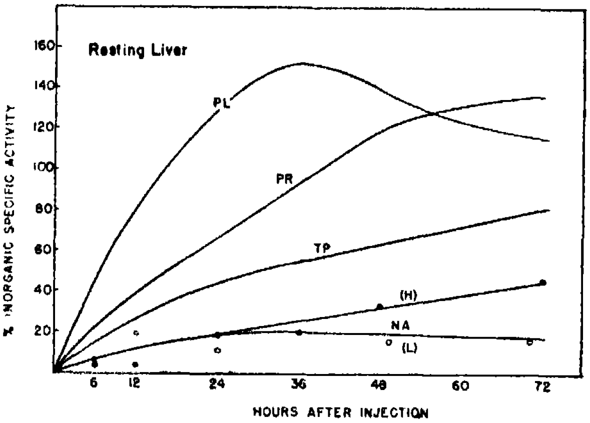

FIG. 1. Resting rat liver. Specific activities of phosphorus fractions at various time intervals after P^{32} injection, expressed as per cent. of the liver inorganic phosphorus specific activity. PL—phospholipids; PR—protein residue; TP—total protein (trichloracetic acid precipitate, free of phospholipids); NA—nucleic acids: (L) obtained by Levene's procedure (open circles); (H) obtained by Hammarsten's method modified (closed circles).

In regenerating liver, however (Fig. 2), the increased P^{32} uptake by nucleic acid is of an order

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[1] L. Hahn and G. Hevesy, *Nature*, 145: 459, 1940.

[2] A. Marshak, *Jour. Gen. Phys.*, 25: 275, 1941.

[3] L. E. Tuttle, L. A. Erf and J. H. Lawrence, *Jour. Clin. Invest.*, 20: 57, 1941.

[4] A. M. Brues, D. R. Drury and M. C. Brues, *Arch. Path.*, 22: 658, 1936.

[5] Proteins were freed of phospholipids by successive 24-hour extractions with 1:3 alcohol-ether, hot alcohol and 1:3 alcohol-ether.

[6] T. P. Kohman and H. P. Rusch, *Proc. Soc. Exp. Biol. Med.*, 46: 403, 1941.

[7] P. A. Levene and L. W. Bass, "Nucleic Acids," p. 299, 1931.

[8] E. Hammarsten, *Biochem. Z.*, 144: 383, 1924.

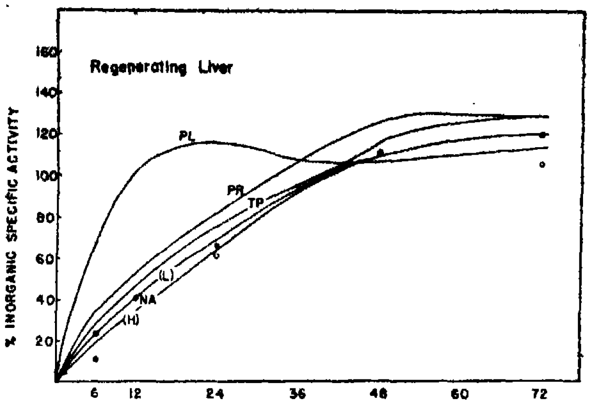

FIG. 2. Regenerating rat liver. Specific activities of phosphorus fractions at various time intervals after P^{32} injection, expressed as per cent. of the liver inorganic phosphorus specific activity. The symbols are the same as in Fig. 1.

of magnitude which can be accounted for by the synthesis of nucleic acid in the formation of new cells. The "protein residue" here apparently has the same rate of turnover as in resting liver, indicating little if any relation to growth. The increased rate of turnover in the "total protein" is therefore due wholly to the higher uptake by its nucleic acid component, confirming Marshak's interpretation on nuclei.[2]

Our results serve to point out the discrepancies between the results of Hahn and Hevesy[1] on nucleic acid and those of Marshak,[2] Tuttle *et al.*[3] and Kohman and Rusch.[6] We have confirmed the observation of the former workers that the turnover of nucleic acid in non-growing liver is very slow. The higher turnover rates found by analyses of "total protein"[3, 6] are not necessarily representative of the nucleic acid portion alone. The relatively higher turnover found by Marshak[2] in the nuclei of resting liver cells probably depends upon fractions of nuclear phosphorus other than nucleic acid phosphorus. Our methods do not distinguish cytoplasmic from nuclear nucleic acids, and some evidence has been obtained that the former have a higher rate of phosphorus turnover than the latter.[9] Thus the resting turnover of nuclear nucleic acids may be even lower than shown by our figures.

The present results lend chemical confirmation to the belief that the nucleus is the stable element in the cell, and point to the nucleic acid component as a compound ensuring this stability. Changes in the more labile compounds within the cell can readily occur through shifts in the steady state, in which rapid synthesis and degradation of these compounds are balanced. In the case of nucleic acids, such continuous turnover occurs very slowly, while synthesis takes place rapidly during growth. This distinguishing characteristic of nucleic acids may be of great importance for the mechanism of growth.

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ISOLATION OF A FILTERABLE VIRUS FROM CHICKENS AFFECTED WITH "BLUE COMB" DISEASE

FOR the past several years poultry pathologists throughout the Northeast have repeatedly encountered a disease entity in domestic chickens, and to a lesser extent turkeys, of unknown origin. It is referred to as blue comb, pullet disease, "X" disease and several other such terms referring to the symptoms exhibited or the conditions or time of encounter. Jungherr and Levine[1] have given a detailed description of the gross and microscopic lesions of the disease as well as their observations on its epidemiology and mortality rate. All attempts, with the possible exception of one by Bullis,[2] to transmit this condition from one bird to another of similar age have failed.

At the University of New Hampshire Agricultural Experiment Station in September, 1941, the writer had the opportunity of observing the course of the malady in two flocks in which the attack was extremely acute and severe. Many of the birds were found dead without having been observed sick; others died after an illness of only a few hours. From the blood stream of such acutely affected birds from both flocks we have been able to obtain a filterable agent that grows readily on the chorio-allantoic membrane of chick embryos. One strain has been carried through 56 transfers made at 72- or 96-hour intervals and the other strain through 39 such transfers. A third strain obtained from the eggs of an infected flock is now in its seventh transfer.

When the infected chorio-allantoic membrane, embryo or embryonic fluid are injected into susceptible chickens they, after 84 to 96 hours, become somewhat depressed and cyanotic. Death has not been produced by such an inoculation. If the inoculated birds are sacrificed at the end of 96 or 120 hours the following gross lesions may be observed; subcutaneous edema, generalized icterus, hemorrhages into the skeletal muscles, marked congestion and swelling of liver and kidneys, collection of urates in ureters, petechiation of heart and serus coat of duodenum, sub-periosteal hemorrhage of flat bones, hemorrhage into the lungs and an acute catarrhal or hemorrhagic duodenitis. Various combinations of these lesions will be encountered. If the bird is not sacrificed the lesions will tend to disappear by the seventh day after inoculation. A microscopic examination of the liver of birds sacrificed at the end of 96 hours reveals foci of cloudy swelling. These swollen liver cells also reveal contracted pyknotic nuclei. The kidney changes are more pronounced but are also limited to foci. The epithelial cells lining the tubules show stages of degeneration varying from swelling with contracted pyknotic nuclei to actual destruction of the cells. The glomeruli are markedly swollen and contain few erythrocytes. There is round cell infiltration between the tubules in these foci.

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[9] A. M. Brues, M. M. Tracy and W. E. Cohn, unpublished data.

[1] Erwin Jungherr and J. L. Levine, *Am. Jour. Veterinary Research*, 2: 4, 261–271, 1941.

[2] K. L. Bullis, personal communication, 1941.

A suspension of the feces and intestinal contents of experimentally infected birds is infective to other birds of the same age when given by way of the mouth. A bacterial free filtrate of the feces is infective when injected intraperitoneally. Bacterial free fecal filtrates are also capable of establishing the virus in incubating chick embryos. The virus is readily filterable through either or both the Seitz E-K 3 and the Chamberland-Pasteur L-3 filter.

Since this filterable virus alone does not produce death when injected into birds of a susceptible age we can not, at this time, say with any certainty that it is the sole etiological agent of the so-called "blue comb" disease.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE ULTRACENTRIFUGE WITH PLASTIC ROTOR[1]

THE ultracentrifuge constructions presently in use are based either on the principle of the oil-turbine velocity centrifuge, equipped with mechanical bearings and a vertical steel rotor, or on the principle of the bearing-less "spinning top," which represents an air turbine floating on a cushion of compressed air. The analytical centrifuges of McBain and the concentration and optical centrifuges of Beams, Wyckoff and Pickels and Bauer are derived from the latter type. The most frequently employed rotor material in these constructions is duralumin.

During a recent visit to the Svedberg centrifuge laboratory of Professor J. W. Williams,[2] at the University of Wisconsin, it occurred to the writer that the use of materials of very low density for the construction of ultracentrifuge rotors might result in a considerable simplification of centrifuge design and obviate the necessity of employing expensive steel and aluminum alloys which are now difficult to procure on account of the National War effort. The first trials were made in Madison with 0.5 inches thick discs of polystyrene and of polyacrylic, transparent resins of 1.5 and 2 inches diameter, respectively. With the mechanical assistance of Messrs. E. Hanson and L. Henke these discs were transformed into simple air-turbines. Employing a 2-inch Lucite disc, tank nitrogen as propellant and a primitive optical set-up with a spectacle lens as objective, the sedimentation of aggregated earthworm hemoglobin within the cylindrical fluid cell was photographed with the kind help of Mr. Ch. Vilbrandt. Since the Lucite turbine showed no signs of irreversible deformation, even when spun for 10 minutes at approximately 40,000 r.p.m., the writer felt encouraged to continue these experiments with plastic rotors after his return to New Haven. A 2-inch Lucite turbine was accelerated to 57,000 r.p.m. with the aid of 80 pounds air-pressure per square inch, as measured with the Kahler-Hunt photoelectric speed-measuring circuit. After the mechanical features of the centrifuge had been improved in various respects, the construction of a 6-inch plastic turbine was undertaken with the mechanical aid of Mr. H. Nelson. Throughout the later phase of this work much benefit was derived from the expert advice of Professor F. W. Keator, of the Department of Mechanical Engineering, and several improvements, based on his suggestions, were incorporated in the design.

A schematic drawing of the centrifuge at its present stage of development is reproduced in Fig. 1.

The top speed, thus far attained with this model, has been 17,400 r.p.m. at 48 lbs/sq. inch air-pressure and an estimated free air flow of 40 to 60 cubic feet per minute, yielding a force of 20,200 times gravity at the center of the analytical fluid cell which is situated at a distance of 6 cm from the center of rotation. This speed is sufficient to cover practically the entire size range of plant and animal viruses as given by Stanley,[3] and, in general, to bring about molecular sedimentation, at appreciable rate, of protein particles from about 10^6 molecular weight upwards. As examples of such materials, the sedimentation of earthworm hemoglobin and of Stanley's crystalline

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[1] This work was aided by a grant from The Jane Coffin Childs Memorial Fund for Medical Research.

[2] The writer wishes to thank Professor J. W. Williams for his hospitality and his encouraging interest in this work.

[3] W. M. Stanley, in Handb. d. Virusforschg., p. 538. Wien, 1938.

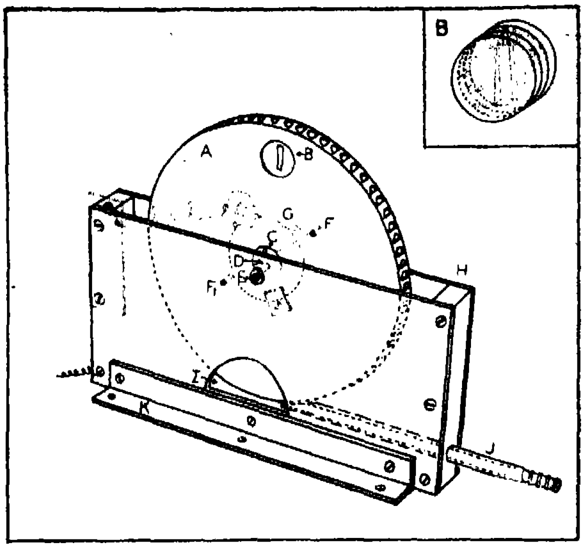

FIG. 1. Air-turbine Ultracentrifuge with Plastic Rotor. A, Lucite rotor, 0.5 inches thick, 6 inches diameter, with flutings milled into the periphery; B, analytical fluid cell (see below), inserted in cylindrical cell hole; C, brass disc, connected with similar disc on other side of rotor by brass bushing and screws; D, axle, made from 3/16 inches thick drill rod, fastened to C and turned down and surface-hardened at ends to fit E; E, Torrington needle bearing, 3/16 inches, mounted in casing, H, and carefully aligned with bearing on opposite side, F, F_1, brass contacts, inserted in rotor surface; G, contact brush, made from spring bronze, insulated from casing H, adjustable in position; H, centrifuge casing, made from sheet brass; I, semi-circular opening in casing, H, to permit free escape of expanded driving air; J, air-jet, 7/32 inches lumen, trumpet-shaped at inlet end and conforming with rotor shape at outlet end; K, angle for mounting on wooden base. Insert B, analytical fluid cell, made by cementing, with Lucite cement, two outer discs of colorless Plexiglas resin to central disc of red Plexiglas into which a sector-shaped opening of 12 mm. height and 8 mm. depth has been cut, connected with periphery by narrow drill hole, through which the solution under study is introduced with a hypodermic syringe. When in use, the cell is inserted into cell hole in rotor with the drill hole pointing towards the rotor center and the broad base of the sector pointing towards the periphery. During operation, the centrifuge is covered by a steel guard, made from 0.5 inch thick boiler plate by welding, equipped with openings opposite the cell holes and slots near the base to permit escape of air stream.

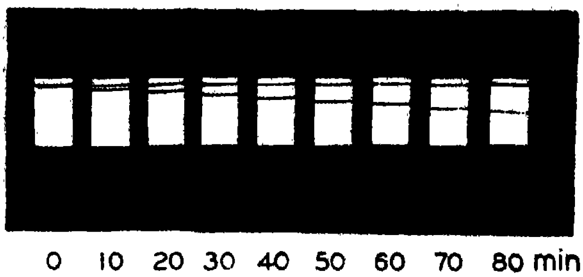

FIG. 2. Sedimentation Diagram of Stanley's Crystalline Tobacco Mosaic Virus Protein obtained with 6-inch Plastic Airturbine. 1 per cent. virus solution; 9,000 r.p.m. (5430 × g.); Toepler schlieren band method; 20 sec. exposures on Eastman contrast lantern slide plate; light source, Mazda 200 watt projection lamp; schlieren lens, Kodak projection lens, F = 4 inches; camera lens, Kodak anastigmatic lens, F = 4 inches.

tobacco mosaic virus protein,[4] with sedimentation constants of $s_{20} = 60 \times 10^{-13}$ and 175×10^{-13} and molecular weights of 3×10^6 and 40×10^6, respectively, has been photographically recorded (Fig. 2), employing the 6-inch Lucite rotor.

The definition of the sedimenting boundaries, as exemplified in Fig. 2, the regular rate of sedimentation during the individual intervals, and the values of the sedimentation constants obtained for the virus with this centrifuge ($s_{20} = 157$ and 161×10^{-13}) as compared with that determined in our Beams ultracentrifuge ($s_{20} = 175 \times 10^{-13}$) for the same preparation, may be regarded as evidence that sedimentation in the plastic rotor proceeds essentially undisturbed by mechanical vibration or thermal convection currents.

The plastic rotors may be adapted to use in *centrifuge microscopes* as well as in *analytical ultracentrifuges.* The contact arrangement indicated in Fig. 1 (parts F and G) has been used to synchronize a stroboscopic light source (*e.g.*, Strobotak of the General Radio Company) with the rotor and to examine living cells during centrifuging with a low-power microscope.[5] In this manner, the stratification of Arbacia eggs has been observed with as yet not wholly satisfactory results.

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[4] The writer is indebted to Dr. W. M. Stanley for a sample of this material.

[5] The author is indebted by Professor N. E. Harvey for valuable advice and the loan of a Strobotak lamp.

NEW BOOKS

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FORTY YEARS OF HELPING THE FARMER WITH KNOWLEDGE[1]

By Dr. W. H. CHANDLER

UNIVERSITY OF CALIFORNIA

IN 1900 the United States Department of Agriculture, state experiment stations, state agricultural colleges and secondary agricultural schools expended about two and a half million dollars, in 1940 more than a hundred and ten million dollars; this last includes the cost of vocational agriculture in high schools. In 1900 many of the colleges were still accepting students with little or no high-school training. Such subjects as mathematics, chemistry, physics and English were taught in courses about equivalent to those taught in high schools, and a considerable percentage of students enrolled in agricultural colleges were taking these courses to prepare for admission to other colleges. The teachers in agricultural subjects seemed to be exceptionally earnest and had developed forcefulness by their contact with robustly critical audiences at farmers' meetings. What most of them taught, excepting teachers in soil science, animal nutrition and entomology, was the result of reasoning from inadequate knowledge of plant and animal processes, experience of exceptional farmers who wrote for farm journals or talked in farmers' meetings and data from rather poor field trials that were beginning to be published.

Soon after 1900 new men were taken on rather rapidly in colleges and experiment stations, mostly men with good personalities who manifested an interest in agricultural problems and had completed only the rather superficial curricula for the bachelor's degree. These undergraduate courses had not been intensive enough to disclose capacity or lack of capacity to study such problems as they would encounter. Many of them never acquired as much scientific training as their teachers had. They tended to emphasize the view that they were practical rather than scientific. Some depended for success upon rather arrogant forcefulness and contact with the influential farmers and business men such as bankers and newspaper men. Many such business men had become interested in improving the farmers and were glad to support plausible efforts by such aggressive young men. Some of these men whose spirits were too animated for patient, effective study, accepted industrial employment during or following the first world war, with companies expecting to profit by farmers' increased purchasing power.

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[1] Parts of the address as retiring vice-president and chairman of the Section on Agriculture, American Association for the Advancement of Science, Dallas, Texas, December 30, 1941.

The ten or fifteen years following about 1900 may, I think, be called the propaganda era in agricultural education. With the purpose of uplifting the farmer quickly men were sometimes employed for extension activities who knew too much: a worker in one agricultural college said that his extension associate could make more discoveries during one lecture than the best scientific worker could make in a lifetime of research. Perhaps the dogma that was the subject of most sermons was that of the water-conserving effect of a dust mulch maintained by diligent cultivation. Yet one experiment station in seeking support now claims to have saved the farmers of its state ten million dollars a year by having discovered that the story of the dust mulch was not true.

By 1904 or a little later many of the agricultural colleges had entrance requirements as high as those of other colleges and the students took the same courses in chemistry, physics, mathematics, botany and zoology as students in colleges of letters and science. These better students tended to be critical of superficial, applied courses. When such students graduated and were employed in the colleges, they wanted to become as well trained as the botanists or zoologists. Somewhat before 1920 such young men were improving the teaching and research of the colleges considerably. Extension activities, however, continued to be of the propaganda type until the representatives of the colleges living near the farmers, the county agents, discovered its ineffectiveness or even harmfulness.

Shortly before and for a number of years after the establishment of farm advisers or county agents in the counties, as a result of the Smith-Lever act in 1914, much was said in extension central offices about salesmanship in presenting ideas to farmers. Extension offices were influenced by what seemed to me a very flatulent pedagogy. To some of the educational advisers the farmers were pathetically dull. One very impressive teacher, from a university that was insulated from farm problems by several million tenement dwellers, was at great pains to tell a convocation of county agents and extension specialists how they could improve their techniques by studying the Hearst newspapers, learning to express themselves in words of one syllable. The actual problem these workers faced was not dullness in the farmers but the uncertainty that what they would say would be true: intensity of personal interest accentuates the understanding of farmers.

Under such influences as these some of the earlier county agents undervalued detailed knowledge of crop and animal problems and overvalued smart politics: skill or imagined skill in manipulating farm groups in the interest of "objectives." In sections that I know, experience has tended to correct this evil. Being so close to the farmers, county agents receive very unpleasant reactions when their manipulations or their objectives prove not to be beneficial. Furthermore, they find that most of the questions good farmers ask can not be answered by any one except after new research, if at all. In the states with which I am acquainted, objectives, smart politics and other heroics have gradually receded, and farm visits, field trials, demonstrations at trial plots and quiet helpfulness at conferences and community center meetings have taken their place.

When a county agent finds questions of considerable importance to his constituents that he can not answer, he gets in touch with an extension specialist from whom he thinks he may obtain an answer. If the specialist can not answer, they consult some one in the experiment station or some conveniently located worker in the U. S. Department of Agriculture. If no one has the answer, a study of the problem may be started, probably in both the field and the laboratory, the county agent keeping interested farmers informed concerning progress of the study. Sometimes the procedure is in the opposite direction: a scientist who has started from leads in the fundamental aspects of his field of study may think he has made discoveries of value to farmers. If he is moderately humane, he does not write a spectacular story for the newspapers and risk causing unwise investments. Instead, he will get trials made cautiously through county agents where the discovery is most apt to be useful.

Probably as many well-trained scientists are doing research in the U. S. Department of Agriculture as in all the experiment stations. I am acquainted only with some parts of the Bureau of Plant Industry; workers in these tend to cooperate with county agents and with the experiment stations and avoid bringing confusion and ill-considered practices onto the farms. Every worker in plant science must be interested in this bureau. In recent years it has been searching the group of graduate students in plant science for the very best men in all the different aspects of botany: probably nearly half the well-trained young men in plant science in the country are in it. Being held each to the solution of certain definite problems, these men bring to their work a continuity of effort that is not always possible for teachers or even for experiment station workers with local obligations. They can follow their leads across state lines or even into foreign countries. They tend to work on problems that the best plant scientists have recommended as needing the comprehensive study a large organization rather well supplied with funds can support. If funds for maintenance of this bureau should be reduced, a considerable part of its special value would be lost, and growth of plant science as well as help to the farmer would be retarded.

County agents are learning, I think, that for effective help on problems that arise in their counties, they must find men whose thinking concerns the processes and responses of crops and animals rather than practices. Little initial help comes from mere trials of practices: farmers' rough trials over wide areas and throughout the years seem to have given nearly all the information that can be given by simple comparisons of practices. In fact, one noted experiment station director has said that experiment stations of the world have spent millions of dollars proving that farmers are right.

Nearly all the information that has enabled farmers to protect their crops and animals against diseases, animal parasites and malnutrition has been obtained by use of techniques in basic sciences such as chemistry, physics, botany or zoology. To become effective in studying crops or animals, or their parasites or soils, and safe in teaching the results of such studies, a man must acquire good training in one or more of these basic sciences and a skeleton of orderly, detailed knowledge concerning the processes, environmental responses and other characteristics, of the group of crops, animals, parasites or soils that constitute his field of study. The graduate student in horticulture, for example, should obtain as much training in chemistry and botany as workers in botany obtain, and this skeleton of knowledge about his class of horticultural plants besides. Even if his undergraduate curriculum contained as much science as a curriculum for students in botany would contain he will need more time for his training than a graduate student in botany would need. Students whose undergraduate training was in schools of chemistry or of letters and science with science majors, are coming to be preferred as graduate students in some departments of soil technology, plant pathology, horticulture, agronomy and other fields in agricultural science; and if applied agricultural courses come to precede courses in sciences in all agricultural colleges, the new workers on agricultural problems are apt to be nearly all from colleges of chemistry or of letters and science.

The system of publishing technical papers, piecing together systems of knowledge about plants, animals or soils, for example, is indispensable for effective aid to farmers. Attempts at graduate or undergraduate teaching or advice to farmers would be hopeless shams without it. A man may be exceptionally well trained when he leaves the graduate school and hopelessly deficient within ten years if he does not have ready access to this growing literature; and, valuable as the county agent is, he would be helpless without the aid it gives him directly, by his own reading, or indirectly, through his contacts with scientists who read it.

This literature, I am convinced, could be used more extensively and more effectively by workers and students if it were published in an orderly system of journals each filed in definite places in libraries and coming regularly to the desks of members of societies for special fields such as horticulture or plant pathology. Such society journals, each publishing all the papers in the country or even in a larger unit, in a fairly well-defined field would not only enable members to use all the new data in their fields more quickly and effectively, they would also give workers in related societies more ready access to such of these data as they might need. The data would probably be more accessible also because presented with less cumbersome discussion and review of literature. Journals published by chemical societies seem to have developed the best system of reporting only records and discussion enough for the needs of workers who use them. Biological societies, such as the American Botanical Society, seem to me to be making great progress in this regard. Apparently, however, they have fewer paying members who do not publish and the nature of their problems make longer reports necessary, so that the dues of such a society will not pay for publishing nearly all data obtained by members. A periodical such as the *Journal of Agricultural Research* that publishes papers from many fields usually does not go regularly to the desk of workers; and if it did it would contain such a large percentage of papers in which a worker is not interested that he would not be apt to develop the habit of examining it carefully. Even a journal of this kind, however, has a great advantage over papers published by experiment stations: it is usually edited by men free from close association with the authors. The average paper in the *Journal of Agricultural Research* seems to me to present its data very much less cumbersomely than the average experiment station technical paper. Because of this cumbersomeness and editions much larger than enough to supply all really interested libraries and workers, publishing in experiment station technical papers is much more expensive than publishing in journals. Experiment stations could publish much more usefully by buying space in journals, and some experience convinces me that they could save 75 to 90 per cent. of their printing cost for technical papers.

Very few men with money for endowments have given support to journals of special scientific societies. By giving only to separate research institutions, they seem to me to be supporting the tool houses around the temple that is being built and ignoring the temple. If they gave to society journals, each a well-placed part of an orderly system of publishing data, they would be improving the breadth of knowledge and vision of teachers and research workers; and at the same time they could be certain that for every dollar they gave to promote economical, effective publication, they would prevent research institutions from spending two or three to ten dollars for expensive, cumbersome publication. In other words, they would be contributing more toward actual conduct of research than if they gave the money directly to the research institution.

Obviously, only a small percentage of graduates of colleges of agriculture can become resident or extension teachers or county agents or research workers. A considerable number obtain positions in which they do not use any of the training they received at college. Observations at a few institutions make me think that agricultural graduates whose training is built around some science, especially chemistry, and those whose training includes a considerable amount of economics are a little more apt to obtain acceptable positions than others. And I believe the boy who goes back to a farm of his own and who is mentally able to use college training will find orderly knowledge of the chemistry and other characteristics of his soils, crops and animals, more helpful in decisions he must make in managing his farm than knowledge from courses built around farm practices.

Men who worked for the establishment of agricultural colleges, and early teachers in the colleges, expected nearly all graduates to operate farms. Rather few have done so, long. A large percentage have not had farms large enough to earn a living, and farm employment rarely can pay enough to permit accumulation of capital. Furthermore, no kind of college training seems to give the graduate as great an advantage in competition with farmers trained merely by farm experience and observation in their communities as was expected. In some states, perhaps because of disappointment at the rather small number of agricultural college graduates who return to the farm, secondary agricultural schools have been established. And a system of high-school training in agricultural subjects has been established throughout the country.

A difficulty that all systems of training for farming encounter is the fact that there are not enough farms for all boys born in country districts: unless an increasing number of farms are to be too small to earn a living for a family or some invention makes small manufacturing units on a farm possible, about a third of the boys born in country districts must find employment off the farm. From experience of other countries and observation in this, we can, I think, be certain that the more farmers we have above the number necessary to farm all the land well, in units large enough to support a family with at least the bare necessities, the smaller the total yield from the farms will be. For when the farm is too small the farm and the family will tend to compete: money that is needed for fertilizer or for better seed may have to go to the family for some desperate need, or the urgency for cash from a single crop such as cotton may prevent rotation of crops to maintain soil fertility. Education, therefore, can not wisely be directed toward keeping more boys on the farm, actually to reduce the national income. When farms are so small that three men are doing the work that two could do as well, the extra farmers will not be contributing as much to the national good as a WPA worker using a shovel to make a road that could be made at a small percentage of the cost with good machinery; for the surplus farmers actually reduce the national income, and we *do* have the road for our payment to the WPA worker.

A school can rarely determine in advance which boy should stay on the farm. Teaching agriculture to a boy who never farms will, perhaps, do no other harm than prevent him from learning something else that would be more helpful to him. If the teaching, however, causes him to remain on the farm and if he finds after he has a family that he made a mistake, it, of course, does him great harm. People who are so anxious to have agriculture taught as widely as possible seem to me to undervalue a good farm as an educational institution. Young men have always improved their farm practice by observing good farms in their neighborhoods. Since the county agent system has become effective, a good farm has become an even better educational institution. On it all knowledge is being used that is known to apply and trials of new discoveries are apt to be in progress. Work on such a farm is probably the best training for actual farming that a boy can obtain.

Of the hundred and ten million dollars expended in agricultural research, extension and resident instruction, somewhat more than fifteen million are for special high-school classes in vocational agriculture under the Smith-Hughes act. Such observations as I have made suggest that nearly all the training of these teachers beyond their undergraduate years is in teaching methods and that after they begin teaching their contacts are with men whose interest is in teaching problems rather than with men who are associated with, and trained to evaluate, the growing body of knowledge about crop, animal and soil problems. In other words, these teachers who have a very great influence on many a boy's life seem to me to be guided by too much pedagogy and too little truth. There seems also to be in the system too much of the point of view in the propaganda era; and the students seem to be taught to expect too great an advantage from these courses when they begin competition with farmers whose knowledge was gained by experience: some of the projects suggest a view that these students will be able to succeed where whole groups of experienced farmers have failed. Some may, of course, succeed in growing and selling breeding stock because of the advertising the project gives them. To win a prize in a Future Farmers of America contest gives economically valuable publicity. The integrity we like to expect from men engaged in any kind of teaching, however, and especially teaching of agricultural science for which confidence has been cultivated at great public expense, demands that these conspicuous successes be not advertised unless the careers of nearly all students in the same classes are studied to see how many are benefited and how many are misled into staying on the farm to fail because of too little capital or unfortunate location, failing perhaps after they have families and find making a change to employment in other industries nearly impossible. In some districts Smith-Hughes teachers are anxious to have as many students as possible, sometimes taking students who go on to college and are handicapped by lack of basic training. If such a student goes to an agricultural college that permits him to take applied courses without science prerequisites he is apt to face life at graduation without opportunity for employment at any work that requires a technique, probably without money to start farming, without experience enough in any basic field to know whether or not he is suitable for graduate work, and with so little basic training that four or five years of graduate work would be required to prepare him for good teaching or research.

Many very fine young men are going into Smith-Hughes work. I believe they would serve farm life more safely and usefully if many of them were employed as special assistant county agents to give attention to young men who are actually beginning to farm instead of having to give so much of their time to boys who will not or should not farm; and if those in the high schools taught mainly the nature and operation of farm machinery, so that whether the boy leaves the farm or stays on it he may find use for what he has learned.

With the Smith-Hughes teaching as now organized, the grave responsibility the teachers assume and their isolation from men trained to study farm problems should cause them to seek the closest possible association with county agents, who have good contacts with both scientists and economists. Help of the county agent, I believe, should always be sought in directing and interpreting Smith-Hughes projects on farms.

I believe that in the school system too many grave, economic decisions are made by reasoning from pedagogic data or pedagogic dogmas. When a boy decides to stay on the farm or the teacher encourages him to do so, *an economic decision is made.* Either the schools should have the advice of men well informed concerning the long-time agricultural outlook and the relation of farming to other parts of the industrial system or teachers should confine themselves to developing aptitudes in basic fields of study or certain handicrafts, and should avoid activities that tend to choose a boy's lifework for him. Certainly a teacher should be reverently modest before the overwhelming complications a boy faces when he is considering farming for a lifework. Great harm can be done by the utterances of pompous high priests of the school system:

> The most important crop is the human crop.
>
> Any community that lets its young men get away is a dead community.
>
> The only place to keep them in the community is on the farm.

I believe good might follow if over the desk of every research worker and every extension worker and every agricultural and soil conservation worker and every teacher, especially every educational administrator, this motto were placed: "Blessed are the meek for they will not mislead their brothers with poorly considered teachings or strutting shams." The God of Nature reveals his laws, I believe, very rarely to the propagandist or to the pompous, or even to the merely zealous, but rather to him who trains diligently in the technique and the records of a system of knowledge, who records his own observations clearly and briefly for the benefit of all workers, who reviews and reorganizes his knowledge frequently in the light of new discoveries, who consults as frequently as possible with workers in his field and related fields, hoping for a vision that points to a safe advance in human welfare, and who is meek enough to see a vision unobscured by projections of himself.

OBITUARY

FRANK COLLINS BAKER

FRANK COLLINS BAKER has been widely recognized as an authority on fresh-water mollusca, on Pleistocene invertebrate paleontology and on museum administration. Born on December 14, 1867, he devoted a long life-time to the services of science. Most of his official positions have involved museum work and research, but through his scientific displays, his genial and kindly personality, and his ambitious program of publication he has had more influence upon the works of others than many who have devoted their whole time to teaching and to the direction of research.

In his concept of a museum were combined the functions of display, teaching and research. For the University of Illinois, where he served as curator of the Museum of Natural History from 1918 until his retirement as curator emeritus in 1939, he built one of the finest teaching museums in this country. At the same time he was amassing study collections in various fields of zoology, archeology and paleontology and carried on a very extensive personal program of research. With his death on May 7, 1942, his broad influence in the several fields of his immediate interests will be felt keenly.

His studies on mollusca were begun in the days when entire attention was focused upon the shells, but he became one of the early investigators to develop the field of malacology. At the time of his death, he had completed the typescript for the first volume of a proposed two-volume monograph on Planorbidae, in which morphology of these snails is treated in exhaustive manner.

Mr. Baker secured his early training at Brown University, in the Philadelphia Academy of Sciences and in the Ward's Natural Science Establishment at Rochester, New York, where so many museum specialists of the earlier generation served an apprenticeship.

In 1894, he became curator of zoology in the Field Columbian Museum of Chicago, but left that post the same year to become curator of the Chicago Academy of Sciences, a position which he held until 1915. From 1915 until 1917 he carried on an intensive quantitative study of relations of bottom fauna in lakes to fish life for the New York State College of Forestry of Syracuse University.

On the invitation of President E. J. James, he came to the University of Illinois as curator in 1918. Here, at the height of his career, he carried forward the development of the university museum at the same time that he was prosecuting a most ambitious research program. Only a few of his major publications can be mentioned here.

In 1911, his "Lymnaeidae of North and Middle America" came off the press and after more than thirty years is still regarded as the most comprehensive treatise on this family. His two volumes on the "Mollusca of the Chicago Area" (1892 and 1902) have been widely used.

After coming to Urbana, he completed "The Life of the Pleistocene," which the university published. This book gained for him very general recognition as a paleontologist. His work in this field was recognized through his election as fellow of the Geological Society of America and by appointment as consultant in Pleistocene invertebrate paleontology on the staff of the Illinois State Geological Survey. The Zoological Society of London honored him by election to corresponding membership in recognition of the soundness of his works.

His two volumes on the "Mollusca of Wisconsin" (1928) are recognized as one of the most comprehensive regional studies of American fresh-water mollusca. The field work for this study was carried on through several summers as a member of the staff of the Wisconsin Geological and Natural History Survey.

In 1939, the Illinois State Natural History Survey published the results of his life-long study of land snails in a "Fieldbook of Illinois Land Snails," to which he had brought two summers of uninterrupted field study on the Survey staff.

In recent years, responsibility for coordination of some programs of field studies in archeology and an interest in the mollusca used by prehistoric races opened up yet another field of activity in which he made several contributions.

He was a regular contributor to the pages of *Nautilus*, where numerous shorter papers on mollusca were published through the years. At the time of his death he was serving as president of the American Malacological Union. It was his fortune to witness the change of museums from "cabinets of curiosity" to educational institutions. He had likewise watched the expansion of the amateur field of conchology to a more mature science. His studies on detailed morphology and on ecological relations of mollusca to their environment have played a part in this transformation.

H. J. VAN CLEAVE

RECENT DEATHS

DR. JOHN M. T. FINNEY, professor of surgery emeritus at the Johns Hopkins University, died on May 30 in his seventy-ninth year.

DR. JAMES D. TRASK, associate professor of pediatrics at the Yale School of Medicine, known for his work on infantile paralysis, died on May 24 in his fifty-second year.

DR. GEORGE P. ENGELHARDT, who retired in 1930 after serving for twenty-eight years as curator of the Department of Natural Sciences of the Brooklyn Museum, died on May 24, at the age of seventy years.

DR. ROY MACKAY, associate professor of mathematics at New Mexico State College, died on May 12, at the age of thirty-eight years.

SCIENTIFIC EVENTS

1941 STALIN PRIZE-WINNERS IN THE U.S.S.R.[1]

OVER two hundred and fifty people—scientists, engineers and inventors—innovators of science and technique—have been honored with the title "Stalin Prize-winners." Through their creative work they have all enriched Soviet science with new achievements.

Among Stalin prize-winners we find names of eminent scientists of the Soviet Union—academicians and professors. The body of academicians and professors are under the guidance of the president of the Academy of Sciences of the U.S.S.R., V. Komarov, and have conducted work in the development of national economy among the Urals under these wartime conditions, for which they have merited and been awarded the First Degree Stalin Prize.

The works of many Soviet physicists are widely known both in the Soviet Union and abroad. Works of the academicians Joffe, Mandelstam and Papalexi are new achievements in the field of physics in the Soviet Union.

The wise investigations of semi-conductors by Joffe have cast light on a very important and complicated question in physics. He has worked out theoretical principles for semi-conductors in industry. On the basis of Joffe's works it has become possible to obtain conductors with many desired properties—new current rectifiers; investigations on photo-conductivity and thermo-electricity have given new powerful thermo-elements ten times superior to those available. For this outstanding work Joffe has been awarded the First Degree Stalin Prize in the department of physico-mathematical sciences.

For many years physicists have been endeavoring to solve the involved problem of ascertaining the nature of distribution of radio waves near the earth's surface. Two Soviet physicists, Mandelstam and Papalexi, have found a successful solution to this problem, for which they have been adjudged Stalin Prizes.

The Stalin prize-winners include the eminent Soviet mathematician, Academician Bernstein, author of numerous works on the theory of probability and the theory of approximated methods of computation. The Soviet mathematician, Khristianovich, has worked out a high theory, near sound-velocity aerodynamics, and has furnished, scientifically, grounded calculations for fast aircraft, thereby meriting the Stalin Prize award.

The numerous investigations in the domain of organic chemistry by Academician N. Zelinsky have played a big part in the technology of motor fuel, synthesis of aromatic carbohydrates, and in the sphere of defense chemistry. His work, published in 1941, contains about four hundred original investigations, for which he has been adjudged the Stalin Prize.

Satpaev, Kazakh geologist, has theoretically worked out the morphology and genesis of Djezkazgan in cuprous sandstone and has supplied valuable conclusions regarding the deposits of copper, iron, manganese and polymetallic ores and coal of Kazakhstan.

In the domain of the science of biology, the First Degree Stalin Prize has been awarded to Professor Y. Parnas, of the Ukrainian Academy of Sciences. In his work, "Gyco-genesis," Parnas crystallizes his numerous investigations on metabolism in muscles; this work, which he conducted at the Lvov University, has now been destroyed.

Biologists adjudged Stalin Prizes include Professor A. Zavarzin. A remarkable work by the author, "Evolutional Histology of the Nervous System," illustrates his theory of evolution of the nerve tissues and of the nervous system, from the simplest organisms up to man. All conclusions are built up on the vast amount of material collected and generalized by the author.

One of the most remarkable scientific works in the domain of medicine is entitled "Particular Pathological Anatomy," by Academicians Abrikosov and Anichkov. The authors have crystallized a tremendous volume of material worked out by them, and have made great contributions to Soviet medical science.

Stalin Prizes likewise have been awarded to the outstanding surgeon, Professor Yudin, for his eminent work on military-field surgery, and also to the famous Leningrad surgeon, Petrov, the outstanding specialist on oncology and cancerous diseases of the stomach.

Under these conditions of the patriotic war, agricultural science acquires particular importance, as it is called upon to help Kolkhoz peasantry ensure provisions for the army and workers of the Soviet Union. The Stalin prize-winners include one of the country's leading zoo-technicians, Dyakov, the author of several works on the feeding of livestock. Dyakov has worked out and introduced the individual feeding of livestock, and has also elaborated upon the principles of the combined-fodder industry.

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[1] Statement by Vice-chairman Stalin for the Prize-winning Committee, S. Kaftanov, *chairman*.

Stalin prizes have also been awarded for the best works of historico-philologic sciences, including collective work group authors, under the guidance of V. Potemkin, "History of Diplomacy."

ANTHROPOLOGICAL SURVEY OF THE PEOPLE OF THE UNITED PROVINCES OF INDIA

ACCORDING to *Current Science,* a monthly Indian journal corresponding in scope to *Nature* and SCIENCE, the Government of India on the recommendation of the census commissioner for India has sanctioned a grant-in-aid for the statistical analysis of the anthropometric data collected by Dr. D. N. Majumdar, of the Lucknow University, in collaboration with the late census superintendent of the United Provinces in respect of the castes and tribes of the provinces. In view of the scientific importance of the work the Statistical Laboratory, Calcutta, under the direction of Professor P. C. Mahalanobis, has agreed to share half the cost of this analysis out of its own funds. The total cost is estimated at Rs.9,000.

Measurements relating to about 4,000 individuals have been collected in accordance with accepted modern technique. The material offers a valuable opportunity for a critical and scientific examination of the very foundations of Indian anthropometry. An appropriate statistical tool is available in the Generalized Distance (D^2-Statistic) the validity of which was fully acknowledged by Professor R. A. Fisher in his paper on "Statistical Utilization of Multiple Measurements" (*Annals of Eugenics,* 1938, 8, 376). It has not been possible, however, to use this new tool so far for lack of suitable material.

It is pointed out that a detailed analysis of the anthropometric material collected now will help in solving the basic problems of comparative anthropometry. It will show, for example, how far the generalized distance can be used for an objective classification of castes and tribes or races of human beings. Secondly, it will enable a standard panel or list of measurements being selected for comparative purposes. This will not only simplify and standardize the procedure of field work in anthropology but will enable valid comparisons being made between measurements taken by different observers. Thirdly, it will enable a critical comparison being made between results based on physical and cultural methods of study. Finally the proposed analysis will supply a scientific basis for the comparative anthropology of the United Provinces and North India generally.

A joint report by Professor P. C. Mahalanobis and Dr. D. N. Majumdar will be submitted to the government of India. Besides this survey, a monograph on some of the important tribes and castes of the United Provinces will also be published for which the Provincial Census authorities have already sanctioned Rs.1,500.

THE INTERNATIONAL GRADUATE SCHOOL EXCHANGE

THROUGH the generosity of the W. K. Kellogg Foundation of Battle Creek, Mich., the Pan American Congress of Ophthalmology announces the establishment of an international graduate student exchange. With the cooperation of the Department of State of the United States Government, twenty-five graduate physicians from Latin America will be brought to the United States for graduate training in ophthalmology. They will be assigned in turn to seventeen of the leading ophthalmic institutions to serve as accessory residents for a minimum of one year, or longer if they show unusual ability. The traveling expenses to and from the country of origin will be paid and each man will receive one thousand dollars a year from the foundation.

The Latin American physicians will be chosen by a committee in each country composed of the dean of the medical school, the professor of ophthalmology and an already existing committee of the American Legation under the supervision of the Department of State. The number of scholarships allotted to each country will be based upon the population and upon the number of ophthalmologists in the country. Applications must be filled through the local professor of ophthalmology and forwarded to the secretaries of the Pan American Congress of Ophthalmology. Those south of Panama are to be sent to Dr. M. Alvaro, São Paulo, Brazil, and those north to Dr. Conrad Berens, New York City. Each application must contain full information regarding the candidate and must bear an exhaustive endorsement by the professor of ophthalmology. After preliminary consideration by the secretarial board of the congress the applications will be returned to the local committees for the selection of candidates. Information about the selectees will be sent by the local committees through the secretaries of the Pan American Congress of Ophthalmology to the foundation for final acceptance.

The following institutions are participating:

The Massachusetts Eye and Ear Infirmary; the Ophthalmic Institute of Columbia University; Bellevue Hospital and College; New York Eye and Ear Infirmary; Wills Eye Hospital of Philadelphia; Wilmer Institute of the Johns Hopkins University; the University of Michigan; the University of Cincinnati; Northwestern University; the Illinois Eye and Ear Infirmary; Cook County Hospital; the Mayo Clinic; the State University of Iowa; Washington University of St. Louis; Tulane University in New Orleans; Leland Stanford University, and the University of California.

WESTINGHOUSE RESEARCH FELLOWS

DR. E. U. CONDON, associate director of the Westinghouse Research Laboratories, announces that three scientific men selected from leading universities have been awarded fellowships to carry on their investigations at the laboratories. The appointees are Dr. Russell E. Fox, University of Virginia; Dr. Gerson S. Schaffel, Carnegie Institute of Technology, and Dr. Robert S. Weisz, Cornell University.

At the Westinghouse Laboratories, Dr. Fox will carry on research on the dynamics of high-speed machinery which he began at the University of Virginia under Professor J. W. Beams. Dr. Schaffel will engage in research on the chemistry of polymers, a basic substance of all plastics, and Dr. Weisz will work in the field of ceramics, specifically attempting to improve the properties of electric porcelain.

This is the fifth group to be selected under the Westinghouse Research Fellowship plan inaugurated in 1938. Appointments are for one year, with reappointment for a second year if mutually desirable. In the past these men have devoted their entire time to investigations in the realm of pure science. This year, however, they have been asked to indicate the fields in which they feel qualified to contribute to war research if their assistance should be required. Three of last year's appointees now are engaged in war research.

Of last year's fellowship winners, Dr. Thomas W. Dakin, Harvard University, has been reappointed for a second year's study. Dr. James S. Koehler, of the University of Pennsylvania, has been granted a year's leave of absence to act as instructor of physics at the Carnegie Institute of Technology. Three other 1941 appointees have joined the Westinghouse research staff. They are Dr. Daniel Alpert, Stanford University; Dr. John W. Coltman, University of Illinois, and Dr. Theodore Holstein, New York University.

THE INDUSTRIAL RESEARCH INSTITUTE

THE fourth annual meeting of the Industrial Research Institute was held in Cleveland, Ohio, on May 22 and 23, with headquarters at the Hotel Statler. Over fifty industrial executives and research directors participated in round table discussions which dealt chiefly with the adjustment of research programs and personnel to meet war conditions.

H. S. Benson, administrative engineer, Research Division, United Shoe Machinery Corporation, Beverly, Mass., was elected chairman, and Wm. R. Hainsworth, vice-president, Servel, Inc., New York, vice-chairman, of the executive committee for the ensuing year. Two new members of the committee were also elected for three-year terms, Philip W. Pillsbury, president of the Pillsbury Flour Mills Company, Minneapolis., and Harold K. Work, manager of research and development, of the Jones and Laughlin Steel Corporation, Pittsburgh.

Guest speakers at a dinner session on Friday evening were Dr. George Crile, the Cleveland surgeon, and his associates, Dr. Otto Glasser and Dr. D. P. Quiring. They described their researches into the nature of the living cell, which have been carried on for the past ten years under the auspices of the Cleveland Clinic Foundation. Inspection visits to the new Thompson Aircraft Products Company plant at Euclid, Ohio, and the General Electric Institute at Nela Park, occupied the members and their guests on Friday afternoon.

The Industrial Research Institute, an affiliate of the National Research Council, undertakes to promote improvement of methods and more economical and effective management in industrial research through the cooperative efforts of its members. The membership is composed of forty-five industrial concerns maintaining research laboratories. Their chief executives in charge of research represent them in the activities of the institute, which has headquarters in Chicago. Other members of the executive committee are F. W. Blair, chemical director, the Procter and Gamble Company, Ivorydale, Ohio; Caryl P. Haskins, president, Haskins Laboratories, New York; Maurice Holland, division of engineering and industrial research, National Research Council, New York, and R. C. Newton, vice-president, Swift and Company, Chicago.

SCIENTIFIC NOTES AND NEWS

BATES COLLEGE, at its commencement exercises on May 24, conferred the doctorate of letters on Dr. Harlow Shapley, director of the Harvard College Observatory.

AT the ninety-second annual commencement exercises of the University of Rochester on May 11, the honorary degree of doctor of science was awarded to Dr. Sewall Wright, distinguished service professor of zoology at the University of Chicago, and to Dr. Frederick Fuller Russell, emeritus professor of preventive medicine and epidemiology at Harvard University.

THE University of New Mexico at its commencement exercises on May 11 conferred the degree of doctor of laws on Professor Douglas Johnson, of Columbia University, who delivered the commencement luncheon address. He spoke on the necessity of employing properly controlled force for the maintenance of law and order in all organized society, international as well as national.

The degree of doctor of engineering was conferred on May 25 at the commencement exercises of the University of Maine on Wilbur L. Merrill, head of the works laboratory of the General Electric Company at Schenectady, N. Y.

The Charles B. Dudley Medal of the American Society for Testing Materials will be presented on June 24 at the annual meeting in Atlantic City to Dr. Francis C. Todd, assistant professor of petroleum and natural gas engineering at the Pennsylvania State College, and to Dr. A. W. Gauger, director of the mineral industries research. The medal is given for a paper read at last year's meeting on "Studies on the Measurement of Water Vapor in Gases."

Nature reports that Dr. Adolf Windaus, professor of chemistry at the University of Göttingen, known for his researches on vitamins, has been awarded the Goethe Medal for Art and Science on the occasion of his sixty-fifth birthday.

Dr. Gustav Egloff, director of research of Universal Oil Products Company, was elected president of the American Institute of Chemists on May 16 at the annual meeting of the institute, held at Atlantic City. Dr. Egloff was the recipient in 1940 of the gold medal which is awarded annually by the institute to the man adjudged to have made significant contributions to chemistry and the welfare of the chemical profession during his career.

Dr. Charles J. Imperatori, of New York, was elected president of the American Laryngological Association at the sixty-fourth annual convention of the association at Atlantic City. Dr. Harold I. Lillie, of the Mayo Clinic, Rochester, Minn., succeeded Dr. Arthur Walter Proetz as first vice-president.

At the annual meeting of the American Association of Botanical Gardens and Arboretums the following officers were elected: Dr. Donald Wyman, Arnold Arboretum, Harvard University, *Chairman;* Henry T. Skinner, Morris Arboretum, University of Pennsylvania, *Vice-chairman;* Clarence C. Godshalk, Morton Arboretum, *Secretary,* and John C. Wister, Arthur Hoyt Scott Foundation, Swarthmore, and Dr. C. Stuart Gager, Brooklyn Botanical Garden, directors.

In honor of Dr. Béla Schick, who is retiring after serving for nineteen years as head of the department of pediatrics at Mount Sinai Hospital, New York City, a fund of $2,000 has been raised by pupils, associates and friends to establish Béla Schick Lectures in his honor.

Dr. George W. Thorn, associate professor of medicine at the Johns Hopkins University, has been appointed Hersey professor of the theory and practice of physic at the Harvard Medical School and physician-in-chief of the Peter Bent Brigham Hospital, to succeed Dr. Soma Weiss, who died recently. Dr. Thorn's best-known work has dealt with the treatment of disease of the endocrine glands, particularly with the treatment of insufficiency of the adrenal glands.

Dr. Jean A. Curran, for the past five years dean of Long Island College of Medicine, Brooklyn, has been elected president of the college. He succeeds Dr. Frank L. Babbott, who retired last September.

Arthur B. Recknagel, since 1913 professor of forestry at Cornell University, has been appointed head of the department of forestry. He succeeds Professor Ralph S. Hosmer, who will retire on July 1.

Dr. Laurence Monroe Klauber, vice-president of the San Diego Consolidated Gas and Electric Company and curator of reptiles in the San Diego Society of Natural History, has been appointed lecturer in natural history at Stanford University.

Dr. Orlando Park, professor of zoology at Northwestern University, has been named honorary curator of zoology of the Chicago Academy of Sciences.

Dr. Randolph T. Major, director of research of Merck and Company, Inc., Rahway, N. J., has been appointed to the Graduate Council of Princeton University.

Orr Goodson has been appointed acting director of Field Museum of Natural History, Chicago, during the absence on war duty of the director, Lieutenant-Colonel Clifford C. Gregg.

Dr. Lowell J. Reed, professor of biostatistics and dean of the School of Hygiene and Public Health at the Johns Hopkins University, has become editor of *Human Biology*. Since the death of Dr. Raymond Pearl the journal has been edited by Mrs. Pearl.

Dr. A. H. Sutton, of the department of geology and geography of the University of Illinois, has been granted leave of absence to become a geologist with the Aluminum Company of America in the Fluorspar District of Western Illinois and Western Kentucky. His address after June 1 will be Aluminum Ore Company, Rosiclare, Illinois.

Dr. Thorne Deuel, chief of the Illinois State Museum since 1938, left on May 22 on leave of absence to rejoin the United States Air Force, in which he served during the first World War. He had resigned from the Air Force in 1919 with the rank of major.

DEVEREUX BUTCHER, staff photographer, artist and editorial assistant of the American Forestry Association, has been appointed executive secretary of the National Parks Association to succeed Edward B. Ballard, who has joined the Army.

THE Annual Symposium of the Society for the Study of Development and Growth will be held this summer at North Truro, Cape Cod, Mass., from August 24 to 28. Those wishing to attend should make reservations at the Whitman House, North Truro, as early as possible. A reservation fee of $1.00 is payable by non-members of the society. North Truro is readily reached by train and bus from both Boston and New York. Further information in regard to the society and symposium may be obtained from Dr. K. V. Thimann, secretary of the Harvard Biological Laboratories.

ONE alumni member, five members and seven associates were initiated by the Lehigh University Chapter of the Society of the Sigma Xi at the annual initiation and banquet on May 14. The retiring president, Bradford Willard, professor of geology, introduced Dr. Robert Cushman Murphy, of the American Museum of Natural History, who gave an illustrated address entitled "By Land and Sea in the Chocó." The officers for the coming year were announced: Allison W. Butts, professor of electrometallurgy, *President;* Lawrence Whitcomb, associate professor of geology; *Vice-president;* W. L. Jenkins, assistant professor of psychology, *Secretary;* E. H. Cutler, assistant professor of mathematics, *Treasurer.*

THE immediate establishment of a Scientific Advisory Council for the war effort has been officially announced in Jerusalem. The council will work in close cooperation with the Government of Palestine. Dr. Judah L. Magnes, president of the Hebrew University, has been appointed president, and Professor Farkas secretary of the council, the membership of which will consist of representatives of the Hebrew University, the Technical High School at Haifa, and the Agricultural and Daniel Sieff Institutes at Rehovot.

THE Institute of Aeronautical Sciences, New York City, has received a gift of $25,000 from Sherman M. Fairchild, aerial camera and aircraft manufacturer. The principal of the fund is to be used for the publication of technical material used by aeronautical engineers.

ACCORDING to the *Journal* of the American Medical Association the Association of Military Surgeons of the United States announces the competition for 1942 for the Sir Henry Wellcome Medal and cash prize of $500 for the best paper on "Measures of Preventive Medicine Recommended by the Federal Medical Services to Insure the Maximum Improvement of the Selectee of 1961 over him of 1941." The competition is open to all medical department officers of the Army, Navy, Public Health Service, organized militia, U. S. Veterans Administration, U. S. volunteers and those in the reserves, commissioned medical officers of foreign military services and all members of the association.

Two prizes of $200 each, offered by A. Cressy Morrison, will be awarded at the annual dinner of the New York Academy of Sciences in December, 1942, for the two most acceptable papers in a field of science covered by the academy or by an affiliated society. Papers embodying the results of original research not previously published should be submitted, on or prior to November 1, to the executive secretary of the New York Academy of Sciences, the American Museum of Natural History, New York, N. Y.

THE Psychological Corporation offers for 1942–1943 James McKeen Cattell grants-in-aid of research in applied psychology. These grants are primarily available to graduate students and are of the value of $250. The closing date for the receipt of applications on forms provided by the Grants-in-Aid Secretary, is July 15, 1942. His address is The Psychological Corporation, 522 Fifth Avenue, New York, N. Y.

THE Westinghouse Electric and Manufacturing Company plant in Jersey City became the first New Jersey plant to win an "all-Navy E" pennant in recognition of continued excellence of production. The plant received an "E" flag last September.

A FIVE-DAY course on tropical medicine was given from May 25 to 29 by the department of medicine of the New York Post-Graduate Medical School of Columbia University, under the direction of Dr. Z. Bercovits. The purpose of this course was to bring to physicians a survey of the fundamentals of the various subjects in tropical medicine, and the more recent advances that have come from research. To this end, arrangements were made to have authorities in their respective fields give lectures and demonstrations in their specialties. Emphasis was placed on the clinical features. Clinical and laboratory material was available for study and demonstration, and the students were given an opportunity for practical work in clinical parasitology.

IN a basic research project recently established by the Navy Department, on problems relating to the operation of specialized aviation instruments, are the following members of the Mellon Institute of Industrial Research of the University of Pittsburgh: Dr. George E. Barker, senior industrial fellow; George E. Alter, industrial fellow, and Charles E. McKnight, fellowship assistant. Other specialists will be added to the staff as the research progresses. A broad survey of the problems involved is being made by Dr. Barker, with the cooperation of the Navy Department, various American instrument manufacturers and other Federal Government laboratories.

WARD'S NATURAL SCIENCE ESTABLISHMENT, INC., which for over eighty years has been conducted in Rochester, N. Y., has moved to a new site on a sixty-five acre tract of land overlooking Irondequoit Bay and Lake Ontario, outside the Rochester city limits. Thirty-five acres are planted with grapes, the remainder being in woodland and pasture. Numerous springs furnish an abundant supply of pure water for cultures and other living material. The departments of mineralogy, paleontology, biology, entomology, and microscope slides and models are housed in a two-story concrete building, and the offices, mailing and photography departments in a large residence near the main building. There are seven other houses on the property and these will eventually be occupied by the Ward employees.

DR. C. P. RHOADS, author with Professor Louis F. Fieser and others of the article entitled "Steroid Hormone Excretion by Normal and Pathological Individuals," in the issue of SCIENCE for May 22, wishes to acknowledge the indebtedness of the authors to the Commonwealth Fund and to the Jane Coffin Childs Memorial Foundation for Medical Research.

DISCUSSION

IN DEFENSE OF THE KALLIKAK STUDY

THE story of the Kallikaks was published in 1912. The larger book, "Feeble-Mindedness: Its Causes and Consequences,"[1] giving the data which seemed to establish the hereditary character of feeble-mindedness, appeared in 1914.

For a decade the data were accepted apparently without question. There seems to have been enough people who were familiar with the details to explain how the study was made, the methods used, the conditions existent, and to answer any questions that arose. But as time went on, the inevitable happened and writers appeared who did not know, who obviously had not read the originals, and who therefore thought they detected certain flaws in the techniques which did not exist.

The first of these appeared in 1925 in "The Inheritance of Mental Disease," by Abraham Myerson, M.D. (pp. 77 *ff.*).[2] To this I paid no public attention because I felt that it was so obviously prejudiced that it would do no harm.

However, fourteen years later, a second book appeared which repeated and added to the errors of the Myerson book. This occurred in 1939 in "You and Heredity," by Amram Scheinfeld (pp. 360 *ff.*).[3]

Again in 1942 the same errors are copied from the preceding sources in "Biology for Better Living," by Ernest E. Bayles and R. Will Burnett (pp. 610 *ff.*).[4]

It therefore seems necessary to correct the errors publicly and attempt to set the record straight.

While much in the way of polish is lacking in this pioneer study, there are certain universal techniques which must be vigorously applied in any careful study; and to certain criticisms of these in Dr. Myerson's book, I wish to refer.

On page 77, Dr. Myerson, in a few lines, makes his only reference to "Feeble-Mindedness: Its Causes and Consequences"—the book which alone contains the data which led to the conclusion that feeble-mindedness is generally hereditary. The Kallikak family is merely a striking illustration.

Dr. Myerson says: "In this book, Goddard decides that feeble-mindedness is a Mendelian trait. He cites some 100 cases in which family studies have been made."

The record shows there are 327 cases carefully studied, charted and explained.

A few lines farther on, Dr. Myerson says: "The keystone of the arch of their results and laws is the field investigator and her surmises as to the mental and physical state of the dead and the quick."

Not understanding the purpose or the methods of the field-worker, Dr. Myerson makes his own assumptions. He argues that because he can not correctly diagnose feeble-mindedness, nobody can. Therefore, all our diagnoses must be guesses and "surmises."

The record shows that our field-workers were carefully trained (see "Feeble-Mindedness," pp. 22–46, 293 and 352). They spent weeks and months in the institution, talking with and observing all grades of defectives. It is well known that superintendents of such institutions quickly learn, and when a new arrival appears they not only know whether he is a fit subject for their institution or is normal and does not belong there, but they also know his *grade*. Even the attendants acquire this ability rather quickly. Dr. Fernald used to enjoy telling how his attendants would spot a child on the train and report that a new case was on the way.

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[1] Henry H. Goddard, "Feeble-Mindedness: Its Causes and Consequences." Macmillan. 1914.

[2] Abraham Myerson, "The Inheritance of Mental Disease." Williams and Wilkins. 1925.

[3] Amram Scheinfeld, "You and Heredity." Frederick A. Stokes Company. 1939.

[4] Ernest R. Bayles and R. Will Burnett, "Biology for Better Living." Silver Burdett Company. 1942.

But these are cases that were *seen*. How about cases in earlier generations, no longer living? Here again Dr. Myerson does not understand—although it is explained in the above references.

The field-worker does not make any "surmises," nor does she ask for anybody's "opinion." Such a method would be naïve indeed. She first asks the prospective informant: "Do you (or did you) know such a person?" If the answer is yes, she proceeds to ask many questions as to how he behaved, what he did, how he managed his affairs.

From this she gets an accurate picture of the kind of person he was. But she does not stop there. This informant may be prejudiced. His account must be corroborated. She hunts up everybody who knew the case. Finally she knows whether he was feeble-minded or normal. If she does not get enough information to decide without a reasonable doubt, the case is "undetermined," and is so marked. Dr. Myerson perhaps did not notice the many squares and circles that were not marked either "F" or "N." The figures are important. On the 327 charts there are 3,996 individuals marked normal (N), 1,946 marked feeble-minded (F): 476 doubtful (?): and 5,892 undetermined (left blank).

Moreover, we are not left without a check-up. After all the individual cases were finished and the charts made, we worked out the "expectation" according to the Mendelian principle, for five different kinds of matings; *e.g.*, if both parents were "F" all the children should be "F." We added all the children of such matings. The record shows 482 children whose status was determined. According to "expectation" they should all be "F." According to our determination, 476 were "F" and 6 were "N." Either we were in error to the extent of six cases, or there was some illegitimacy, or, as some biologists hold, two "F" parents may *rarely* have an "N" child.

The four other kinds of matings gave results equally close to the "expectation." This is all fully explained in "Feeble-Mindedness."

Dr. Myerson next turns his attention to the "Kallikak Family."[5] He ridicules the idea that we could know that the mother of the Kallikaks was feeble-minded, when we "did not even know her name," but had to put her down as "Nameless." I did not realize that it might mislead. All names are fictitious, and it occurred to me that "nameless" would identify her without any possibility of confusion. She is nameless to the reader only. We had her name; and not only her name but her history. We were fortunate enough to find an intelligent lady of advanced age, *who knew personally the "Nameless one."* That seems impossible until one realizes that if each of them had lived to be 80, they could have known each other for eight years or more; and if they had lived to be 90—not impossible—they could have been neighbors for 30 years! The nameless one was neither a prostitute nor a "bar-room habituée."

Perhaps Mr. Scheinfeld can explain how he acquired the information that "In 1898 Dr. H. H. Goddard, then director of an institution for mental defectives in New Jersey, chanced upon the strange fact, etc."

It is no misprint, because he repeats with emphasis on the next page "Remember, this study was begun in 1898, before there was any science of genetics."

The facts are these: I was never director of an institution for mental defectives and I did not begin the study of the Kallikaks in 1898. It was begun in 1910 and published in 1912.

Mr. Scheinfeld contributes one original idea—wrong like the rest. He says: "The comparison rests largely on *the assumption* (italics his) that the illegitimate child whom the feeble-minded mother chose to call Martin Kallikak, Jr., was indeed the son of the man she designated, which no court would accept as evidence."

A strange statement. Courts have always accepted such evidence and still do. In this case there was not even a doubt.

For the rest, Mr. Scheinfeld devotes a few paragraphs to prove the obvious.

Certainly Martin Kallikak, Sr., must have been a "Simplex," else his son by the "Nameless" would have been normal. But that is no argument. It is well known that a trait may remain recessive for generations as long as its possessors mate with "duplexes."

Finally we come to Bayles and Burnett. Their treatment of the matter is so much like Scheinfeld's that it has already been answered. With parrot-like accuracy they repeat Scheinfeld's error: "In 1898 Dr. H. H. Goddard began a study of two family lines that had a common ancestor," and on the next page, "Remember that the study was begun in 1898." They add, "Remember that Mendel's work was not known to the scientific world until 1900." And in the next paragraph, "Intelligence tests did not even exist when the study was made."

They are so sure of all this that they add "The persons in Goddard's study were classed as feeble-minded simply upon the basis of opinions of persons who had known them or who knew (however vaguely) of them." (Reminiscent of Dr. Myerson!)

The record shows that the Binet tests were extensively used by us in both studies. (See "Kallikak Family," pp. 71 and 88, also "Feeble-Mindedness," pp. 4 and 183, and see index.)

That these authors copied, uncritically, Scheinfeld's errors, including the absurd date, seems obvious. Even a cursory reading of the "Kallikak Family"[5] or "Feeble-Mindedness" would have shown them that intelligence tests were in constant use.

Perhaps it is possible to regard these glaring errors as natural mistakes; but it is difficult not to feel that some, at least, result from wishful thinking.

In these days, one can not read everything. But if one feels it necessary to publicly criticize, it would seem that he should be sure that he understands what he is condemning. This would be not only for his own protection, but for the far more important consideration, the preservation of truth and the advancement of science.

Henry H. Goddard

The Ohio State University

THE GRAYING OF HAIR

Dr. Aleš Hrdlička's[1] recently publicized explanation that as one of the functions of the hair is to excrete melanin, graying of the hair is, therefore, a quantitative expression of the total amount of melanin to be excreted by the body, which in some way, not explained, depends on the metabolism. Thus, according to Dr. Hrdlička, graying is an automatic expression of the dying fires of metabolism, and no drug or chemical can be expected to have more than a temporary effect.

The color pattern of the hair is not only generally, but also somatically inherited. If this were not so we might be startled to find our leopard losing her spots and the tiger his stripes. Moreover, we would be at a complete loss to explain the white tips on black fox fur or the reverse on ermine.

That the coloring of the hair is functional in character and not automatically dependent on some generalized bodily change or growth is most clearly shown by the fact that certain animals, as the Arctic fox, change the entire color of the hair from winter to summer season, which is coupled with the moulting function; also shown in birds, like the ptarmigan. Moreover, in birds, and to some extent in mammals, the pattern of the hair coloring changes with sex activities, remarkably confirmable by experiment. In humans, both the hair coloring and its time-duration is a hereditary matter and independent of general health, virility or age.

Moreover, much evidence goes to show that melanin formation is a local matter. Commonly, for example, one finds the scalp hair white over the site of a former injury, although there is a good hair growth continuing. This is also true in other pigmented tissues, such as the skin. Pregnancy, lice, irritation, etc., cause marked localized pigmentary changes. On the other hand, as yet unknown factors cause marked patch withdrawal of pigmentation (Vitiligo) peculiarly striking in colored people. The Negro's hair grays with age; his skin doesn't, which fact I find impossible to coordinate with Dr. Hrdlička's idea of general melanin excretion.

While sex seems to play an important role in hair coloring, nevertheless, albinos breed quite freely, as laboratory rats and mice amply demonstrate.

That the matter is not a simple concomitant of growth or nutrition is well illustrated by the fact that the "bald" area rarely becomes markedly gray primarily, and often completes its own peculiar function without any graying whatever. The lateral margins of the scalp, on the other hand, most commonly gray first and they, on the contrary, rarely become bald.

All the above facts are but a small selection of the large number illustrating the same matter; namely, that while there are many outside controls reacting on the actual machinery of pigmentation, nevertheless, this is a separate entity. Moreover, each cell shows a quantitative difference in its reactivity to such controls so that hairs growing side by side may show very marked pigmentary contrasts. Such facts leave little doubt that the fiber pigmentation is a special function, and unless this be a solitary exception to the general rules of physiology, it is capable of being altered in a quantitative manner by pharmacological agents.

Dr. Owen S. Gibbs,
Director of Research

Medical Research Division,
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SOME FACTORS AFFECTING APPLE SCALD DISEASE

The scald disease of the apple is a storage disorder which causes tremendous wastage in storage wherever apples are stored the world around. The cause of this disease was found by workers in the U. S. Department of Agriculture to be accumulations of certain volatiles around the fruit in storage.[1] They devised a method of control in which these volatiles were absorbed by paper wraps impregnated with mineral oil.

Two years' results on the Rhode Island Greening variety indicate that coating the fruit with a wax emulsion (Brytene 489 AM) gave considerable promise in scald control. On prematurely picked apples, the wax treatment did not give as good control as the oiled paper treatment, but on pickings made at the normal time it gave as good control as oiled paper. Waxing has the advantage over the oiled paper treatment in that it keeps the fruit in a more green, crisp condition. It is suggested that small commercial trials of this wax treatment be made. A concentration of 6 to 8 per cent. solids in the emulsion is suggested.

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[5] Henry H. Goddard, "The Kallikak Family." Macmillan. 1912.

[1] *Jour. Am. Med. Asn.*, March 14, 1942, p. 918.

[1] C. Brooks, J. S. Cooley and D. F. Fisher, *Jour. Agr. Res.*, 18: 211–240, 1919.

It was found that the volatiles from one lot of apples may induce scald on a second lot. Susceptible varieties scald much sooner and more severely in the presence of volatiles from McIntosh apples than when stored alone. This was true both in ordinary cold storage practice and in "controlled atmosphere storage," where carbon dioxide and oxygen levels as well as temperature and humidity were controlled.

Progress has been made in "air conditioning" the storage atmosphere to rid it of these harmful volatiles, but absolute scald control by this method has not yet been attained. The more promising materials which have been used in the air-conditioning process have been various oils and activated charcoal. Failure to attain complete control of the disease by this method may be attributed partially to a lack of knowledge as to when the absorbing materials became saturated.

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A GRASSHOPPER PROBLEM IN MECHANICS

A FRIEND on a farm, having to move a hive full of bees, asked me whether the hive would weigh less if the bees were stirred up so as to fly around inside the closed hive while she carried it. This suggested a similar—but mathematically simpler—problem: Will a suitcase containing a pound of grasshoppers weigh less if the grasshoppers are jumping so that half of them are constantly in the air in the suitcase than if all are constantly at rest?

If a grasshopper of mass m jumps with a vertical velocity v, the downward impulse on the suitcase is mv when he jumps and also when he alights, which will be $2v/g$ seconds later if he strikes nothing; therefore if n grasshoppers are in the air half the time, the average downward impulsive force due to the change in momentum is one half of $2nmv$ divided by $2v/g$, that is $\frac{1}{2}nmg$; and this added to the weight of those at rest gives the dead weight of all. In other words, the total average weight is the same whether they are jumping or not. This is, of course, the kinetic theory explanation of the downward pressure exerted by the weight of a gas. It should be noted, however, that only the average weight is the same. If a box containing a single grasshopper is suspended from a sensitive spring balance, every time he jumps the box will receive a downward kick. So the indicated weight of any body not at absolute zero is partly static and partly kinetic, and is a statistical average sum of varying static and impulsive forces.

The hive-and-bees problem is more complex; but in this case also, of course, the total average weight must be the same no matter what the actions or motions of the bees and other parts inside the closed container may be.

This problem is doubtless very old, though I do not happen to have run across it before. References to previous discussions of it will be appreciated.

GORDON S. FULCHER

WASHINGTON, D. C.

SCIENTIFIC BOOKS

EPILEPSY

Epilepsy and Cerebral Localization. By WILDER PENFIELD and THEODORE C. ERICKSON. 607 pp. Springfield, Illinois: Charles C Thomas. 1941.

A RARE kind of devotion to suffering humanity and science is needed to keep a man working at a disease such as epilepsy. The patients are deeply distressed and distressing to the physician because many can not be given much aid. Lennox in his recent book, "Science and Seizures," has shown this spirit and has written a book from the medical and social view-point. Now comes "Epilepsy and Cerebral Localization," by Penfield and Erickson, from the surgeon's point of view. But these men are more than surgeons; they have approached the entity called "epilepsy" from the physiological standpoint; they have made histological studies and finally, with the aid of the special laboratories of Dr. Jasper and Mrs. Erickson, respectively, they have taken up electroencephalography and psychology, as related to epilepsy.

A series of proven cases of focal epilepsy treated by craniotomy provided the major source of material for physiological, psychological and anatomical studies of the human cerebral cortex over a ten-year period. The histology of cerebral scars, the cytology of the brain, the structure and control of cerebral vessels and the physiology of cerebral blood flow have formed the subjects of what might be called their preliminary research. During the process of clinical elaboration, collateral studies were made upon patients suffering from all types of convulsive states by electroencephalography and pneumoencephalography as well as by the analysis of seizure pattern and clinical picture. At the same time related medical literature has been freely used. For students of neurophysiology the direct observations made upon the cerebral cortex of conscious patients and the descriptions of patterns of epileptic discharge provide valuable material. The chapter on cranial roentgenography treats chiefly the atrophic lesions of the brain and skull. Because of the fact that war came upon the world before the completion of the manuscript, Chapter XIX on acute head injuries has been added. The treatment of atrophic cerebral lesions and of brain tumors is described in practical detail. An exhaustive report is made of the results of operations (Chapter X). Over a ten-year period 165 operations were performed for the removal of cerebral or meningocerebral scars. Thirty-four of these proved to be "negative explorations"; in 62 there was removal of a meningocerebral cicatrice; in 53 the cicatrix was cerebral only. Since operation 22 per cent. of the former and 19 per cent. of the latter patients have been entirely free from attacks. An additional 54 per cent. of the patients with meningocerebral scars were conspicuously improved, the corresponding figure for purely cerebral scars being 40 per cent. Only 11 per cent. of the former and 3 per cent. of the latter showed no improvement at all. In short, these operations are well worth doing and if the scar involves both meninges and brain, there is a nine to one chance of clinical improvement and a one to four chance of cure, with an operative mortality of 4 per cent. Moreover, the improved techniques of pneumoencephalography are a great aid in determining which cases should be explored surgically. For example, many brain tumors are found, some of them removable. The results from removal of encapsulated tumors are about 20 per cent. cured of seizures and 40 per cent. conspicuously improved; infiltrating tumors only do about half as well.

The chapters on "Seizure Patterns" and "Mechanism of Epileptic Seizures" bring much important data to the physiologist who is interested in the function of the human brain. The authors define epilepsy as the tendency to recurring epileptic seizures. "An epileptic seizure is a state produced by an abnormal excessive neuronal discharge within the central nervous system. An epileptic seizure is therefore a symptom of disease, but epilepsy itself should not, strictly speaking, be used as a name for that disease." Seizures have one common feature: a direct influence upon the central nervous system, which results in recurring explosive neuronal discharges. On pathological grounds, they differ widely. Anatomically, the part of the central nervous system wherein the neuronal discharge occurs may vary greatly, but there is a common physiological mechanism which produces the outward manifestations of a seizure.

From a practical point of view, in the consideration of many of the epilepsies, the cause is readily recognized, *e.g.*, cases of brain tumor, traumatic scar of the cerebral cortex and hypoglycemia. Such types have been called *symptomatic epilepsy.* But after one names the long list of pathological lesions that may affect the brain and after the obvious extra-cerebral causes are enumerated there remains a residue, an all-too-numerous group of cases in which the cause can not at present be found. To these patients the term *cryptogenic epilepsy* (of obscure origin) has been applied. This group will contain a large number of cases in which there is a strong familial tendency and in which the electroencephalographic record has a characteristic form, the spike and slow wave described by Gibbs, Gibbs and Lennox. Many of these cases will be found to fall into the clinical classification of "petit mal."

The careful clinical research for focal symptoms; the operations under local anesthesia and the refined exploration of the cortex in conscious patients have brought in a wealth of important material. The clinical descriptions of various seizures and their classification in relation to localization and electroencephalography is also a distinct advance. The medical profession has been too willing to put the attacks into three vague and loosely defined categories: "grand mal," "petit mal" and "psychomotor attack." As generally used, these terms are meaningless from the physiological standpoint and inadequate clinically. If used accurately in their classical sense, they would not cover the field at all. Penfield brings this out in his clinical analysis and Jasper substantiates the neurological observations with the electroencephalogram (Chapter XIV). Jasper makes four salient points:

> (1) Epilepsy, as viewed by electroencephalography, consists of recurring paroxysmal high voltage waves, electrical signs of excessive synchronized neuronal discharge or *hypersynchrony.* Often, but not always, there are associated abnormal rates of cerebral discharge or dysrhythmia, tachyrhythmia or bradyrhythmia.
>
> (2) The epilepsies may be divided into three principal groups with regard to localization of abnormal waves: (a) *localized* to a specific cortical area of one hemisphere, (b) *bilaterally synchronous* from homologous areas of the two hemispheres, and (c) *diffuse* wide-spread disorganized abnormal waves often with generalized cerebral tachyrhythmia or bradyrhythmia.
>
> (3) The form of local cortical epileptic discharge recorded near its source is the same from any superficial cortical area while the form of clinical seizure depends upon the function of cortical area of onset and path of march.
>
> (4) There is a close correspondence between cortical localization by the E.E.G. and the localization arrived at by analysis of the nature of onset of the clinical seizure.

The book is obviously written from a wide experience in surgical cases, but the authors have also seen in their clinic and practice a large number of epileptics of the cryptogenic type and they have two chapters on these more medical aspects (XI and XII).

The inheritance of epilepsy is discussed and the data are well presented, but it seems to me that the obvious conclusion is not drawn, *i.e.*, that "idiopathic epilepsy" is identical with "inherited epilepsy," and that all other cases have cerebral lesions. Of course there is always the group of "cause unknown" ("cryptogenic," if you prefer Greek) because the doctor lacks diagnostic means. At any rate I feel that the time has come to drop the term "idiopathic."

Under "extracerebral causes" are discussed various systemic variants of circulation, water metabolism, etc., which effect fits. The authors clearly state that epilepsy is cerebral and that these are really precipitating causes, if causes at all. Nevertheless, some are important in treatment.

In a disease where the most important symptom is clouding of consciousness or loss of it, the subject of "consciousness" must come up for discussion. At the end of Chapter VI, on "Functional Levels in the Central Nervous System," the highest level is considered "the level of consciousness" and four pages are given to a discussion which I consider the weakest part of the book. I can not believe that consciousness is a one-level affair and I do not agree that there is an area of "highest level of integration," the integrity of which is essential to consciousness. That such a "level of final integration" lies within the diencephalon seems most improbable. The epileptologist certainly knows a lot about *un*consciousness, but he is taking chances when he lightly discusses consciousness in a few pages without careful definition of what he means. It remains the great mystery.

This book contains little about the end results of epilepsy seen in institutions; it does not discuss many of the problems that arise in large epileptic hospitals. From that point of view the book is not a treatise on the care of the epileptic. The authors are not distracted by the older clinical writings which look on epilepsy as a "disease" that "leads to deterioration." They start physiologically and hold to their physiology, applying it to clinical phenomena. Therefore, and because of its scope and data, I think this is the best book ever written on epilepsy.

STANLEY COBB

SOCIETIES AND MEETINGS

THE EIGHTH ANNUAL WASHINGTON CONFERENCE OF THEORETICAL PHYSICS

THE topic of the Eighth Annual Washington Conference of Theoretical Physics, held on April 23, 24 and 25 in Washington, D. C., at the George Washington University, under the joint auspices of the Carnegie Institution of Washington and the George Washington University, was "The Problems of Stellar Evolution and Cosmology."

This topic represents essentially the further development of discussions at the Fourth Conference of May, 1938, on "Problems of Stellar Energy-Sources." During the four years since that conference, many problems pertaining to the process of energy-production in stars became completely clarified and present now a solid basis for further advances in this field. There seems hardly any doubt that the so-called "carbon cycle," first proposed by Dr. H. Bethe at the Fourth Conference, actually represents the source of energy for our sun and for all other stars of the "main sequence." It is also becoming more and more certain that the energy-source of the so-called "red-giant stars" lies in the thermonuclear reactions of the three light elements, lithium, beryllium and boron, as was proposed by Dr. G. Gamow and Dr. E. Teller.

But, whereas we know the particular nuclear reactions which are responsible for the energy-production in various types of stars, the problem of stellar evolution, that is, changes with time of the observable characteristics of a star particularly in its application to the "red giants," still presents serious difficulties. Because of the absence of any appreciable convection-currents through the entire body of the star, it seems that the nuclear transformation of various chemical elements in the star should take place in a spherical shell, the radius of which is steadily increasing in the process of evolution. This necessitates the study of the so-called "shell-model" of a star as first proposed by Gamow during the Fourth Conference. Study of this model was considerably advanced during the last year by Dr. S. Chandrasekhar and Dr. M. Schoenberg, who reported their results at the first session of the Eighth Conference.

It was shown by Chandrasekhar that the growth of the "shell" does not extend all the way to the surface of the star but stops when the shell envelops 35 per cent. of the total mass of the star. When the shell, for example, corresponding to the transformation of lithium, has reached its maximum extent, the star undergoes a rapid process of gravitational contraction and the new shell corresponding to the next element (beryllium in this case) starts to grow from the center.

Schoenberg has investigated a special case (of particular interest for the sun and the stars of the main sequence) where the molecular weight of the stellar matter changes as the result of the nuclear transformations in the growing shell. His calculations lead to the interesting conclusion that, at the end of its hydrogen-evolution, our sun will increase in luminosity only by a factor of three and not by a factor of one hundred, as was previously concluded from the old homogeneous model.

Considerable discussion followed Schoenberg's statement that in the process of shell-growth, the potential energy of the star reaches a minimum, and that the star may become unstable at this particular point of its evolution and be subject to periodic pulsations of the Cepheid-variable type. It was indicated by Teller that, according to Cowling's theory of stellar stability, pulsations of the type proposed by Schoenberg should not be expected.

On the question of the "mixing-up" process in a stellar interior, Dr. G. Randers reported his calculations of the convection-processes in rotating stars. His conclusion is that the so-called "Eddington convection currents" are balanced by the more rapid rotation of the stellar equatorial regions and hence no exchange of material between the deep interior of the star and its surface should be expected.

Following the reports on the "shell-model" the discussion shifted to the problem of the correlation of various theoretical viewpoints on stellar evolution and the observational facts on the relative abundance of stars of various types. Dr. H. Shapley gave a general survey of the observational evidence and stressed the point that the familiar pattern of the Russell diagram is essentially based on the study of one particular part of our stellar system (a large-scale region surrounding the sun) which should not be considered as a fair sample of the entire stellar universe. Indeed, it has been found that the relative number of various star-types is quite different for the central and outer regions of the galaxies; quite different results are also obtained in globular and irregular stellar clusters. Thus, in any attempt to correlate the theoretical picture of stellar evolution with the observational material, one must necessarily take into account this general stellar population in various parts of the universe.

The second important problem of the conference (mostly during the session on April 24) was that of the expanding universe and the related question of the origin of chemical elements during the early stages of the expansion. It should be noted that there is still considerable disagreement among investigators as to whether our universe is an expanding one. In a recent publication Dr. E. Hubble, interpreting the observed red-shift as due to Doppler-effect of receding nebulae, arrives at a conclusion not in accordance with geological evidence. Thus his calculated age of the universe is only about one billion years, that is, considerably shorter than the geologically estimated age of the earth. However, Gamow indicated that Hubble's result is based on the distance-scale obtained by assuming that the intrinsic luminosity of nebulae remains constant even if their ages differ by hundreds of millions of years. The above-mentioned discrepancy is easily explained by assuming that the luminosity of nebulae may decrease during such long periods of time by a few per cent. A decrease of this order might well be expected because of changes during stellar evolution and the escape ("evaporation") of stars from separate nebulae. Thus the solution of the problem of the expanding universe must await more information regarding the evolutionary history of separate nebulae.

The other angle of the problem was discussed by Dr. L. H. Thomas, who reported his attempt to explain the red-shifts in the spectra of distant light-sources as resulting from the interaction of the traveling light-quanta with the free electrons in interstellar space. His calculations were entirely on the basis of classical electrodynamics, but there is still the question whether his result will hold in quantum-mechanical treatment.

It is, however, desirable to retain the hypothesis of the expanding universe, since it provides a basis by which a great many phenomena may be explained. The most important of these is the riddle of the origin of chemical elements—a process requiring high temperatures and densities such as could have existed only in the early stages of an expanding universe. It may be easily shown that under the most extreme conditions now existing in the interior of various stars, only the lightest elements of the periodic system could be transformed from one to the other. To explain the presence and the observed relative abundance of all heavier elements—in particular the existence of uranium, thorium, etc.—one must necessarily assume that two or three billion years ago the density of matter in space exceeded ten million times that of water and the temperature was as great as several billion degrees. These are just the conditions corresponding to the early stages of the expanding universe.

The attempts to explain the observed relative abundance of various chemical elements have been hitherto followed in two different directions: (1) That the present abundance arises from some kind of chemical equilibrium between various nuclei at certain high temperature and density; (2) that the origin of elements is a breaking-up process similar to the recently discovered process of uranium-fission. Both points of view were discussed during the second session of the conference and it was agreed that the second point of view is the more probable. In his report on the "equilibrium-theory" Chandrasekhar indicated that the observed abundance of the elements from oxygen to argon may be well represented by an equilibrium-state corresponding to a temperature of 8×10^9 °C and density of 10^7. On the other hand, the abundance of heavier elements calculated under these assumptions decreases much too rapidly; thus the computed abundance of the elements at the end of the periodic table is 10^{10} times smaller than the observed values. Empirically, the abundance-curves run almost horizontally, beginning at the middle of the periodic system which, as it is easy to see, can not correspond to any state of chemical equilibrium.

Discussion centered mainly around the possibility that the heavy elements originated at still higher temperature and density and that their relative proportions were later "frozen up" in the process of expansion. This discussion led to the conclusion that the "freezing up" process could hardly take place since, in the presence of free neutrons, heavy elements would be transformed into light ones (through the "neutron-evaporation"), even at much lower temperatures. It seems, therefore, more plausible that the elements originated in a process of explosive character, which took place at the "beginning of time" and resulted in the present expansion of the universe. Some details of such breaking-up process of the heavy fragments of primary nuclear matter which would finally lead to the ordinary nuclei of the known stable elements were discussed by Teller.

The third day of the conference was devoted to fundamental problems of physical constants and the properties of elementary particles. Teller presented his criticism of Dirac's recent view that the number of elementary particles in the universe and also the value of the gravitational constant are slowly changing with time. He indicated that, assuming Dirac's hypothesis, one would expect large changes in the luminosity of the sun, which is contrary to geological evidence.

Thomas presented his recent attempt to build up a formalism for consistent quantization of the electromagnetic field which would eliminate the difficulties inherent in the infinite self-energy of elementary particles.

Dr. W. Pauli discussed the theory of the "meson" on the assumption of zero-spin and concluded that this assumption is not very satisfactory.

Twenty-six investigators from 15 universities and research organizations took part in the conference. These were: British Central Scientific Office (Greenwich Observatory), R. d'E. Atkinson; Carnegie Institution of Washington, J. A. Fleming; Catholic University of America, K. F. Herzfeld; University of Chicago (Yerkes Observatory), S. Chandrasekhar, G. Randers and M. Schoenberg; Columbia University, W. E. Lamb, A. Nordsieck, F. Perrin and S. Rosenblum; Harvard University, C. L. Critchfield and H. Shapley; Institute for Advanced Study, W. Pauli; the Johns Hopkins University, D. R. Inglis; Ohio State University, L. H. Thomas; Princeton University, S. Rosseland; National Bureau of Standards, G. Chertog; Navy Department, Bureau of Ships, R. Richtmyer; Naval Ordnance Laboratory, T. Page; Naval Research Laboratory, R. Gunn; George Washington University, H. V. Argo, Th. B. Brown, G. Gamow, Miss M. F. Langs, R. J. Seeger and E. Teller. Several leading nuclear physicists and astronomers from various parts of the country who had also accepted invitation to take part in the conference could not do so because of urgent unexpected demands of their national-defense problems.

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REPORTS

THE FIRST ANNUAL REPORT OF THE CHAIRMAN OF THE NATIONAL SCIENCE FUND

Last year when the Board of Directors[1] of the National Science Fund met to complete the organization of the National Science Fund, our country was still at peace. On December 7, 1941, midway in the first year's development program, it was necessary to stop and reconsider the aims of the fund and to determine whether under war conditions the National Science Fund could and should continue. The Executive Committee concluded that although the National Science Fund may not stand in the full current of military progress, war makes it imperative to put forth our greatest efforts to assure continued adequate support for basic research in science. Even though fundamental research should fail to produce a single discovery applicable to the war, it still would be essential to the future peace. Vice-president Henry A. Wallace has made it clear that he understands how important it is for us to face these realities: "From the practical standpoint of putting first things first, at a time when there are not enough hours in a day and every minute counts, planning for the future peace must of necessity be a part of our all-out war program." To preserve and advance our democratic civilization after the war is over will demand full use of basic discoveries made by research scientists during these war years. It is not putting the matter too strongly to say that the basis for any lasting peace when this war is over may well be founded on some discovery made by research in fundamental science.

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[1] The Board of Directors for the year 1942–43 is composed of the following: *Chairman:* William J. Robbins; *Vice Chairman:* Winthrop W. Aldrich; Roger Adams, James R. Angell, James F. Bell, Albert F. Blakeslee, Isaiah Bowman, Arthur H. Compton, James B. Conant, Edwin G. Conklin, John W. Davis, Luther P. Eisenhart, Homer L. Ferguson, Herbert S. Gasser, Walter S. Gifford, Ross G. Harrison, Carlton J. H. Hayes, Herbert Hoover, Jerome C. Hunsaker (Treasurer), Frank B. Jewett, Ernest O. Lawrence, Frank R. Lillie, Archibald MacLeish, Robert A. Millikan, Harvey S. Mudd, Alfred N. Richards, Elihu Root, Jr., Harlow Shapley, Tom K. Smith, Lewis L. Strauss, Harold H. Swift, George H. Whipple.

The National Science Fund's major aim is to cooperate in making it possible for this research to go on. By securing the understanding and enlisting the support of the public, new private funds can be put to work to supplement the research budgets of university and other privately endowed laboratories, where the crippling blows of shrinking investment income and reduced tuition have compelled curtailment or cessation of important researches. War brings home to the American people the importance of applications of science. Many now understand that mathematicians apply modern theory of probability to the strategy and tactics of aerial fighting and to improving the accuracy of gunfire; that psychologists and botanists contribute to camouflage; that physiologists study war-time diet and drugs. Pearl Harbor has already shown us what the sulfonamide drugs can do to reduce the toll of war injuries. A physiologist tells us that his research indicates that the successful solution of several problems in aviation medicine may contribute materially to the outcome of the war.

These applications of science are understandable to most people, but too many fail to realize that we can not make American science fully productive unless we can maintain fundamental research, and enable those scientists who stand outside the direct scope of the government's war research program to carry on their important work. In the National Science Fund, a potentially powerful means of advancing human welfare through science is already in existence. It is truly dedicated to the service of all humanity and all science, and not to the individual interests of any one sector or to any individual institution. It is prepared to receive and administer funds for the advancement of science under an organization which guarantees so far as is humanly possible that any money entrusted to it will be safeguarded as to principal and income and invested to the greatest advantage in science. It is further prepared to act as a clearinghouse for questions from prospective donors on the support of science or from scientists who need financial assistance for their researches. The National Science Fund offers the possibility of serving donors who have funds they wish devoted to science, of serving science by increasing its support and of serving all humanity through the advancement of science.

The chief concern of the National Science Fund in its first year's activity has been to contribute toward a greater general understanding of the value of fundamental science, the necessity for its support and the fact that the National Science Fund has a unique machinery for this financing. A public relations program was first directed to scientists and scientific workers because it was felt that their wholehearted understanding and support was essential for the long-term successful development of such a fund. An 8-page brochure entitled "Philanthropy in Science" was widely distributed. Through the cooperation of Dr. Langmuir, president of the American Association for the Advancement of Science, the fund was presented to each of the 15 sections and to the 179 societies affiliated with the association. Representatives described the fund before many of the major scientific meeting and notes, articles or editorials appeared in numerous periodicals read by scientists. A series of four radio programs was presented over a national network. Effort is now being directed to professional groups of laymen and to the general public.

In anticipation of enlisting public interest and support two surveys were made with the help of leading scientists to determine current critical areas of scientific research. The results of these surveys, which are of considerable interest, will be published. In addition a partial review of the grants-in-aid made by the National Academy of Sciences over the past twenty years from its trust funds was made. Under the auspices of the National Science Fund a detailed and documented study of the relation of fundamental research to practical applications has been initiated by a student of the history of science which will illustrate the vital interest the general public has in fundamental science—and in its adequate support.

Although the National Science Fund during its first year of operation has had no funds for direct appropriation more than 50 requests for financing research have been received. These have been carefully reviewed and where circumstances warranted the applicant was put in touch with potential sources of funds. In several instances assistance was made available. The National Science Fund has also acted as a consultant on several projects which bear directly or indirectly on the war effort. In thus acting as a clearinghouse the fund appears to be performing a function not otherwise adequately met. It is hoped that as time passes there will be more prospective donors who will ask the National Science Fund to locate qualified scientists whose research they could support or to point out areas for research where money could be wisely used for the public good.

SPECIAL ARTICLES

THE PRODUCTION OF PERMANENT HYPERGLYCEMIA AND GLYCOSURIA BY THE PROLONGED ADMINISTRATION OF INSULIN

It is apparent from the studies of Haist, Campbell and Best[1] and of Lukens and Dohan[2] that insulin, fasting or fat-feeding rests the islands of Langerhans, and that the procedures which permit the islets to rest also prevent or hinder the development of the diabetic state which results from the administration of anterior pituitary extracts to dogs. Accordingly, Haist, Campbell and Best recommended that the procedures established as beneficial for animals should be tried in man as a prophylactic measure for the prevention of diabetes, especially in the case of children with a diabetic family history.

However, since the administration of exogenous insulin can reduce the insulin content of the normal pancreas, it is possible also that it may depress completely the production of insulin and thereby induce a permanent diabetes in a patient with a relative deficiency. In order to put this possibility to test, from 30 to 75 per cent. of the pancreas was removed from dogs. Since such animals can become diabetic only if hyperglycemia is induced by the administration either of large amounts of carbohydrate or of anterior pituitary extracts, they may be regarded as being very susceptible to diabetes, but not as having diabetes. Such a situation may exist in the patient who eventually becomes diabetic.

After the immediate post-operative effects were over, the animals were treated with protamine zinc insulin to the limits of their capacity and were permitted to eat freely. The blood sugar level was studied carefully to maintain a constant hypoglycemia. In three animals that were studied for over one year, it was noted that hyperglycemia and glycosuria appeared in from 20 to 40 weeks after the beginning of the protamine zinc insulin treatment. Furthermore, these animals apparently developed a permanent diabetes since the hyperglycemia and glycosuria persisted for as long as 30 weeks thereafter.

Fig. 1 illustrates the history of a dog from which a maximum of 66 per cent. of the pancreas was removed and which, after several days, was started on daily injections of protamine zinc insulin, the dosage being increased to the limits of the animal's capacity to withstand hypoglycemia. The animal was permitted to eat freely and what remained was measured. It was noted that the blood sugar did not reach hyperglycemic values even when, in the 18th week, insulin was stopped for several days. Up until the 22nd week the animal's weight rose gradually and then a precipitous fall occurred. Thereafter, the animal exhibited all signs and symptoms of pancreatic diabetes with hyperglycemia, glycosuria and ketosis, the latter being apparent after insulin deprivation. With the administration of adequate amounts of insulin for the remaining 30 weeks of the study, the animal could be rendered aglycosuric. The degree of glycosuria was definitely related to the amount of carbohydrate ingested. Insulin was removed on the 54th week and the animal died in a cachectic state 11 days later.

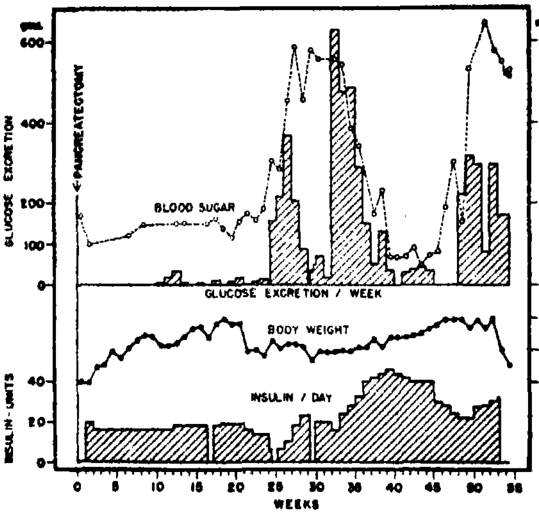

FIG. 1. Illustrating the influence of the prolonged administration of protamine zinc insulin to a partially depancreatized dog. The blood sugar values are the highest obtained during the week.

Autopsy revealed 4 grams of pancreas which did not appear abnormal on gross examination. Repeated sections made from numerous blocks of this tissue revealed no normal islet tissue. Only a rare area was found suggesting an islet of Langerhans that apparently was undergoing involution. These few islets were small, inconspicuous and showed changes suggestive of fibrosis.

In order to illustrate further the fact that the diabetes which was produced in consequence of the prolonged administration of protamine zinc insulin was essentially indistinguishable from that which results from total pancreatectomy, various periods during which insulin was stopped in the dog are depicted in Fig. 2. During the first and 18th weeks after operation, the removal of exogenous insulin did not result in glycosuria or hyperglycemia. However, during the 25th week glycosuria became apparent after exogenous insulin deprivation, and hyperglycemia more so thereafter.

These studies are in accord with the observations that insulin administration results in a decrease in the production of insulin by the islet tissue.[1,2] However, it is apparent that the prolonged use of protamine zinc insulin accentuates this phenomenon to such a degree that a "disuse atrophy" of the pancreas ensues.

---

[1] B. E. Haist, J. Campbell and C. H. Best, *New England Jour. Med.*, 223: 607, 1940.

[2] F. D. W. Lukens and F. C. Dohan, *Endocrinology*, 30: 175, 1942.

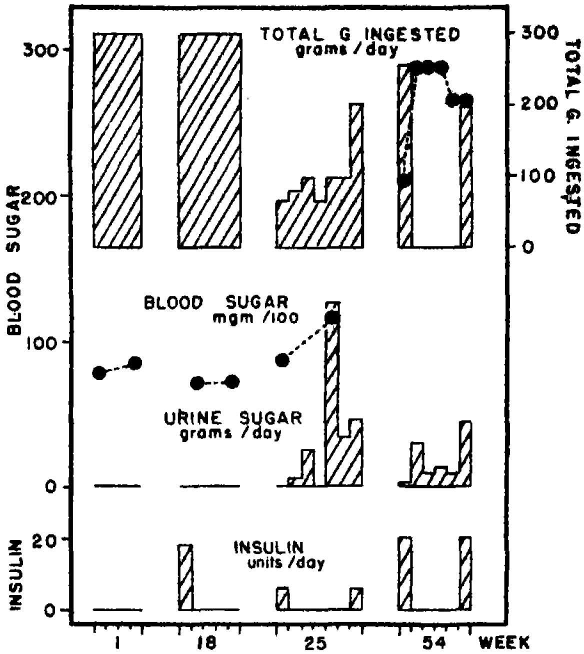

FIG. 2. Illustrating the influence of insulin deprivation at various intervals after the administration of protamine zinc insulin to a partially depancreatized dog.

This compensatory decrease in insulin secretion and its morphological counterpart is made more evident in these experiments, where the amount of pancreas present in the animal is relatively small, though adequate for normal maintenance. It is suggested, therefore, that it might be an extremely dangerous practice to utilize protamine zinc insulin as a prophylactic measure in man, in contrast to its beneficial influence in diabetes mellitus.

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ON CATARACT AND CERTAIN OTHER MANIFESTATIONS OF TRYPTOPHANE DEFICIENCY IN RATS[1]

IT is recognized that tryptophane deficiency leads to lesions in the eyes. Curtis, Hauge and Kraybill[2] in 1932 and Totter and Day[3] in 1941 reported the occurrence of cataract in tryptophane deficient rats, and the latter observers also noted vascularization of the cornea in this condition. We can amply confirm and extend these observations, and we have furthermore noted lesions characteristic of tryptophane deficiency in other organs.

TRYPTOPHANE CATARACTS

In our experiments a tryptophane deficient diet[4] similar to that employed by Totter and Day[3] (No. 5000) was employed. Young rats of about 100 grams in weight, when placed on this diet, developed cataracts with great regularity in from seven to eleven weeks, in contrast to paired feeding control animals on analogous diets containing tryptophane. Two different types of cataract have been observed in the tryptophane deficient animals—an *acute* and a *chronic* type.

The *acute type* starts in the posterior cortex of the lens, spreading within a few days to the perinuclear, nuclear and anterior cortical zones and maturing within two to three weeks. Within a week after the maturation of the cataract the animals die. The acute form of cataract can be arrested in its early stages by supplementing the diet with tryptophane, but some opacities still develop for a time after the supplement is instituted.

The *chronic type* of cataract is confined to the anterior and posterior cortex of the lens and does not mature within the life-time of the animals, which varies from four to nine weeks after the onset of the cataract. In one animal we have observed a combination of the morphological features of both types of cataract. We do not know what factors determine the type of cataract which develops, but our results suggest that the strain of rats studied may be important.

We have observed cataracts *only in growing animals* on a tryptophane deficient diet. Adult animals have so far failed to develop any evidence of cataract.

---

[3] Leo Lehman fellow.

[1] This study was supported in part by grants for the study of amino acids in nutrition made by the Rockefeller Foundation, Merck and Company, Eli Lilly and Company and E. R. Squibb and Sons. This material was presented in part at a demonstration at the meeting of the Federation of American Societies for Experimental Biology in Boston, March, 1942. W. Buschke, A. A. Albanese and R. H. Follis, Jr., *Fed. Proc.*, 1: 175, 1942.

[2] P. B. Curtis, S. M. Hauge and H. R. Kraybill, *Jour. Nutr.*, 5: 502, 1932.

[3] J. R. Totter and P. L. Day, *Jour. Biol. Chem.*, 140: cxxxiv, 1941.

[4] The exact composition of the diet was as follows: Protein (acid hydrolyzed casein concentrate), 147 g; l-cystine, 1.5 g; sucrose, 150 g; starch, 420 g; agar, 20 g; salt mixture (see below), 20 g; Crisco, 190 g; Mead Johnson's cod liver oil substitute, 50 g; water to make to proper consistency. The salt mixture used had the following composition: NaCl, 18.9 g; $CaHPO_4$ anhydrous, 25.0 g; $MgSO_4$ anhydrous, 6.86 g; $KHCO_3$, 44.4 g; KCl, 3.66 g; Fe citrate U.S.P., 2.21 g; $CuSO_4$ anhydrous, 0.24 g; $MnSO_4$ anhydrous, 0.15 g; KI, 0.015 g; NaF, 0.03 g.

OTHER LESIONS IN TRYPTOPHANE DEFICIENT RATS

In addition to cataract formation, we have observed a variety of other lesions in rats on a tryptophane deficient diet.

1. *Vascularization of the cornea,* with characteristic superficial capillary loops, has developed in the majority of our tryptophane deficient rats, both adult and growing rats. This can at least be partially reversed by a tryptophane supplement.

2. *Alopecia* has developed in our animals, both young and old. In many animals, notably the young ones, it has been most conspicuous about the head and back, while in other animals it has affected primarily the back, abdomen and hindlegs. Restoration of hair growth has been observed following the administration of a tryptophane supplement.

3. *The incisor teeth* show defects in the enamel and loss of color; they are brittle and misshapen. This has been observed so far only in growing rats.

4. *Atrophy of the testis and aspermiogenesis* have been observed in male animals.[5]

It is apparent that continuously growing epithelial structures bear the brunt of the lesions in this deficiency. However, the lesions are not confined to such tissues, for there is also found a retardation of growth and a loss of skin turgor which can not be so explained. The animals exhibit a hunched posture such as is encountered in a number of other deficient states.

A CLASSIFICATION OF CATARACTS

On the basis of their morphological characteristics, their mode of development as observed with the slitlamp and their association with particular lesions in other organs we can differentiate the tryptophane deficiency cataracts from:

A. *The diabetic group of cataracts* (cataract in experimental[6] and clinical diabetes,[7] galactose[8] and xylose[9] cataracts). These are characterized in some stages by the prevalence of subcapsular vacuoles (particularly beneath the anterior lens capsule); they are associated with polyuria and polydipsia, with an abnormally high monosaccharide concentration of the blood.[9]

B. *The tetanic group of cataracts* (cataracts in idiopathic[10] and in postoperative parathyroid tetany[11] and rachitic tetany[12]) which are characterized by the zonular *development* of the cataracts in association with a diminished calcium : phosphate ratio in the blood and with the typical neuromuscular manifestations of tetany. These cataracts are occasionally accompanied by the lesions associated with group C and are probably more closely related to the latter group than to group A.

C. The third group of cataracts, in which that of tryptophane deficiency must be included, may be termed the *epitheliodystrophic group,* which includes the cataract attributed to riboflavin deficiency;[13] chronic thallium poisoning;[14] x-ray damage; the cataract of scleroderma and poikiloderma (Rothmund-Werner Syndrome);[15] of atopic eczema (Andogsky-Kugelberg Syndrome)[16] and of myotonia atrophica (Steinert-Batten-Gibb).[17] In addition to the absence of the features of group A, some of these cataracts are characterized by their polymorphism, and all of them are associated with other epithelial lesions. A more complete analysis of the classification of "metabolic" cataracts, including that of tryptophane deficiency, and a bibliography of other syndromes associated with cataract will be reported elsewhere.[18]

Among the members of group C the tryptophane deficiency cataract seems to resemble most closely the cataracts described in riboflavin deficiency and in thallium poisoning. But all the members of this group show striking similarities in their concomitant manifestations. Involvement of the cornea has been observed in connection with each of these conditions of the group, although the corneal lesions have shown some differences. Each of these conditions has been accompanied by alopecia and other skin lesions. Atrophy of the gonads has been described in all these conditions with the exception of atopic eczema. Developmental changes in the teeth have so far been observed only in tryptophane deficiency and in some cases of syndermatotic cataract.[19, 20]

COMMENT

Our finding that tryptophane deficiency gives rise to a variety of characteristic lesions lends strong support to the view that this amino acid has specific functions to perform in addition to serving as a building block for body proteins. Although the changes in tryptophane deficiency are not identical with those seen in other conditions causing epitheliodystrophic cataracts, the similarity of the pathological picture is striking and suggests that some common metabolic path is interrupted in these disturbances.

---

[5] Landrum B. Shettles, personal communication.

[6] One of us (Buschke) is at present engaged with Dr. Curt P. Richter in the study of experimental diabetic cataract in rats which has made possible for the first time the comparison of diabetic and galactose cataracts in the same species.

[7] A. Meesmann, Die Mikroskopie des lebenden Auges. Berlin-Wien. Urban-Schwarzenberg, 1927.

[8] H. S. Mitchell and G. M. Cook, *Arch. Ophth.*, 19: 22, 1938.

[9] N. J. Darby and P. L. Day, *Jour. Biol. Chem.*, 123: 505, 1940.

[10] A. Meesmann, Hypocalcaemie und Linse. Stuttgart, F. Enke, 1938.

[11] H. Goldmann, *Graefe's Arch. Ophth.*, 122: 146, 1929.

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[13] C. S. O'Brien, *Arch. Ophth.*, 8: 880, 1932.

[14] A. Buschke, *Arch. f. Derm. Syphil.*, 116: 477, 1913. J. Donski, *Graefe's Arch. Ophth.*, 128: 294, 1932.

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[16] W. P. Beetham, *Arch. Ophth.*, 24: 21, 1940.

[17] B. Fleischer, *Graefe's Arch. Ophth.*, 96: 91, 1918.

[18] W. Buschke, *Arch. Ophth.*, in prep.

[19] I. Kugelberg, *Klin. Mbl. Augenheilk.*, 92: 484, 1934.

[20] A. E. Maumenee and W. Buschke, unpublished observation.

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A VIRUS INACTIVATOR FROM YEAST

THE ability of certain bacteria to inactivate tobacco mosaic virus was reported by Mulvania.[1] Johnson and Hoggan[2] found that a number of fungi as well as bacteria could cause inactivation of tobacco mosaic virus and suggested that this inactivation was most likely due to the utilization of the virus constituents by these organisms. The high rate of inactivation by *Aerobacter aerogenes* and *Aspergillus niger* later led Johnson[3] to suspect that a virus inhibitor was produced by these organisms. Broth cultures of the organisms were found to contain a growth product (or products) capable of inactivating several plant viruses *in vitro* and in dried-leaf tissue. Efforts to separate the active substance from the culture medium yielded discouraging results.[4]

Johnson and Hoggan[2] grew a yeast, *Saccharomyces sp.*, in a medium containing filtered tobacco mosaic virus and broth for 8 days, but could not detect a reduction in the concentration of virus due to the action of the yeast in this mixture. Extraction of an inhibitor from the yeast was not attempted by these workers.

In the work reported below a virus inactivator has been extracted from yeast by autolysis and by autoclaving. A simple method for extracting this substance is as follows: one kilo of frozen baker's or brewer's yeast cake is mixed with 4 liters of distilled water and autoclaved for 30 minutes at 15 pounds pressure. The autoclaved material is filtered through a pad of Celite No. 505. The pale yellow, somewhat opalescent filtrate is treated with two volumes of acetone or alcohol and the resulting bulky, white precipitate is separated from the liquid by centrifugation. The precipitate is dissolved in a volume of distilled water equal to that of the original filtrate. The precipitation and solution in water may be repeated several times, but a small amount of an electrolyte such as NaCl must be added to effect complete precipitation. This partially purified substance was used for much of the preliminary work. Later, for more exact work, the inactivator was further purified by clearing with safranine and neutral lead acetate, followed by heating in 2N HCl. In more detail, 33.3 cc of a 1 per cent. solution of safranin per liter of inactivator were used and the neutral lead acetate (saturated) was added dropwise until no further precipitation took place. Potassium oxalate and $CaCl_2$ were used to free the solution of lead and oxalate, respectively. After precipitating with acetone the supernatant liquid was discarded, the precipitate dissolved in 2N HCl and heated on a boiling water bath for ½ hour. Six to seven volumes of acetone were required to effect the final precipitation. The white precipitate was dried for several days in a desiccator, then ground into a powder before weighing.

TABLE 1

THE INACTIVATION OF PURIFIED TOBACCO MOSAIC VIRUS BY DIFFERENT CONCENTRATIONS OF A PURIFIED INACTIVATOR FROM YEAST

Milligrams of inactivator per 100 cc of a suspension containing 5 mg of virus	Local lesions on 20 half leaves		Per cent. of virus remaining active	Per cent. of virus inactivated
	Treated virus	Untreated virus		
0.303	493	1520	32.3	67.8
0.625	209	1359	14.8	85.2
1.25	164	1614	10.05	89.95
2.50	44	1398	3.14	96.86
5.00	22	1547	1.42	98.58

Each step in the purification process and the effect of different treatments were followed by mixing a solution of the test material with a solution of purified virus. The changes in virus concentration brought about by the inactivator were measured by inoculating half leaves of *Nicotiana glutinosa*. In all cases, one half of each of 20 leaves was inoculated with each treated sample and the other halves with corresponding controls. The ultracentrifugally purified tobacco mosaic virus used in these experiments was kindly supplied by Dr. W. M. Stanley, of the Rockefeller Institute for Medical Research, at Princeton, N. J.

The reaction between the inactivator and the virus is rapid. The results of a typical experiment tabulated above show that with each doubling of inactivator concentration a halving of active virus concentration takes place. This strongly suggests a chemical reaction between one unit of inactivator and one unit of virus rather than an adsorption phenomenon. Furthermore, the inactivator does not combine with heat-denatured virus. The virus-inactivator combination can be broken if the mixture is heated to 99° C. for 10 minutes.

Scions of rose, peach and pear taken from virus-infected parent plants were placed in a solution of the inactivator for several days and later grafted on healthy stock. This treatment did not prevent the appearance of typical symptoms of each disease. Sets of detached leaves from mosaic and healthy plants were placed with their petioles in a solution of the inactivator and in distilled water for 9 days. A study of different combinations of juices from these leaves showed that although the inactivator had entered the leaves evidence for its entrance into the living cells and the destruction of the virus therein was not conclusive.

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[1] M. Mulvania, *Phytopath.*, 16: 853–871, 1926.

[2] James Johnson and Isme A. Hoggan, *Phytopath.*, 27: 1014–1027, 1937.

[3] James Johnson, SCIENCE, 88: 552–553, 1938.

[4] James Johnson, *Phytopath.*, 31: 679–701, 1941.

The activity of the substance is destroyed by heating with 1N NaOH on a boiling water bath but is unaffected by 2N HCl under the same conditions. In some cases an increase in activity was detected after the acid treatment. Treatment with trypsin or emulsin does not impair its activity. The usual protein tests are negative. Microchemical analysis of the purified substance gave: N—negligible, C—39.70 per cent., H—5.85 per cent., S—0 per cent., Chlorides—1.40 per cent., and ash—negligible. Fehling's solution is not reduced, but a strongly positive Molisch's alpha-napthol test is shown. On the basis of this test and the ratio of C to H it is suggested that the substance is a polysaccharide.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW PETRI DISH COVER AND TECHNIQUE FOR USE IN THE CULTIVATION OF ANAEROBES AND MICRO-AEROPHILES

THIS Petri dish cover, which has been designed to work in combination with a solid medium containing a reducing agent, makes possible the surface cultivation of anaerobes and micro-aerophiles without the use of anaerobe jars, petrolatum seals or chemicals other than those included in the medium itself.

Any good infusion agar containing a satisfactory reducing agent is poured into the usual Petri dish and allowed to harden. Either a pour or streak plate may be made. After the agar has solidified, the Petri dish cover is replaced by the anaerobic lid (Fig. 1), which is so designed that it touches the agar at the periphery and results in trapping a small amount of air over the surface of the agar. The reducing agent in the medium uses up the oxygen in this small amount of air and an anaerobic condition exists. The glass rim on the lid forms a seal with the moist solidified agar, and no other seal is necessary. If 1 cc of 1:500 methylene blue is added to each liter of agar to act as an indicator, the reduced center of the media in the dish becomes colorless, while the oxygenated periphery for about 5 mm remains blue.

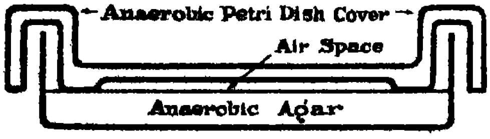

FIG. 1. Cross section showing anaerobic Petri dish cover in use.

A tentative formula for a suitable agar is as follows:

Infusion agar or blood agar base (containing 1.5 to 2 per cent. agar)	1,000 cc
Sodium Thioglycollate[1]	2 grams
Dextrose	10 grams
Methylene Blue 1 cc of 1:500 solution	
pH	7.5

This agar should be distributed in about 40 cc amounts if 100 × 15 mm Petri dishes are used and 25 cc amounts if 100 × 10 mm dishes are used. The 40 cc dishes are more satisfactory and may be incubated longer without drying out. The depth of agar in the dish must be sufficient so that the rim of the anaerobic cover rests on the surface of the agar and not on the Petri dish at any point.

We have found that Cl. tetani, Cl. novyi, Cl. septique and Cl. welchii give good surface colonies in 48 to 72 hours and that the plates may be incubated several days longer without drying out. In most cases the growth was much better than that obtained with the same culture in an anaerobe jar. If an unglazed procelain top is used in pouring the plates, better isolation of surface colonies will be obtained. To facilitate opening the dish, the cover should be turned slightly to break the agar seal.

This technique may be used with the usual agar for obtaining partially anaerobic conditions for the cultivation of micro-aerophiles.

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CONTRIBUTION TO THE STEREOCHEMISTRY OF DIPHENYLPOLYENES

IN the series of the diphenylpolyenes, $C_6H_5 \cdot (CH = CH)_n \cdot C_6H_5$, which have been studied especially in the important investigations by Kuhn and Winterstein,[1] so far as we know no stereoisomer of the all-trans compounds has hitherto been prepared in the case $n > 3$.

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[1] One gram of sodium formaldehyde sulfoxylate and two grams of sodium thioglycollate seem to give a much quicker reduction.

In a related field, that of the natural polyenes, the C_{40}-carotenoids, methods have been used in some laboratories[2] for the preparation of stereoisomers, *viz.*, reversible isomerization by refluxing solutions, by iodine or HCl catalysis, and by melting crystals. Irradiation can also be effective. As the adsorption affinity of stereoisomers varies with the configuration, they can be separated by chromatographic analysis.

We have now found that the methods mentioned are applicable to the diphenylpolyenes, in particular diphenyloctatetraene, and that the stereoisomers can be separated by developing the chromatogram with benzene-petroleum ether mixtures on calcium hydroxide. The reversibility of the trans-cis shift becomes manifest by spontaneous reisomerization, each of the separated isomers yielding a mixture in which the all-trans compound prevails. So far two new partially cis-isomers of diphenyloctatetraene have been observed below the zone of the starting material. They are followed by several minor zones which are under investigation. Since the adsorbates mentioned are almost colorless, the developing of the chromatogram has been followed by their fluorescence in ultraviolet light.

We expect to study other synthetic polyenes by the methods indicated.

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A SIMPLE MEANS OF RETAINING OIL BETWEEN SLIDE AND CONDENSER

THE condensers of most research microscopes are optically designed for homogeneous immersion against the lower surface of the slide. If the air gap is left open, only a fraction of the numerical aperture of the immersion objective is utilized.

Unfortunately, many condensers are so constructed that when a slide of the usual thickness is used, the gap between its lower surface and the top lens of the focused condenser is about 1 mm. Cedar oil does not possess sufficient surface tension to hold it in place in a gap this large. It soon runs to one side, and is, in general, so troublesome that most cytologists do without it except for particular critical figures.

This difficulty can be overcome by filling most of the gap with glass, leaving only thin spaces to be filled with oil. One obtains a piece of glass of the proper thickness (I used a thin slide), and cuts a piece which will a little more than cover the top lens of the condenser. One puts a drop of oil on this glass insert and lowers it onto the condenser. One lowers the condenser slightly, then puts a drop of oil on the under surface of the slide and places the slide on the stage. One raises the condenser back into focus, and optical contact is thereby established. Since the glass is of the same refractive index as the oil, it is as if the gap were filled entirely with oil. If the glass insert is not too thick, there will be no difficulty in focusing. If it is not too thin, there will be no tendency for the oil to run out. Several different inserts may be needed, for use with slides of various thickness. One can conveniently keep the condenser immersed during an entire working day. Depending on the size of the hole in the stage, a greater or lesser area of the slide can be searched without smearing. Then one must pause, wipe the oil off the under surface of the slide, put on a fresh drop in the proper place, and start again.

This method is so simple that it has probably been used before. However, it newly occurred to the author, and was new to several cytologists to whom it was mentioned.

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IS THERE LIFE ON THE OTHER WORLDS?[1]

By Sir JAMES JEANS

PROFESSOR OF ASTRONOMY

So long as the earth was believed to be the center of the universe the question of life on other worlds could hardly arise; there were no other worlds in the astronomical sense, although a heaven above and a hell beneath might form adjuncts to this world. The cosmology of the *Divina Commedia* is typical of its period. In 1440 we find Nicholas of Cusa comparing our earth, as Pythagoras had done before him, to the other stars, although without expressing any opinion as to whether these other stars were inhabited or not. At the end of the next century Giordano Bruno wrote that "there are endless particular worlds similar to this of the earth." He plainly supposed these other worlds—"the moon, planets and other stars, which are infinite in number"—to be inhabited, since he regarded their creation as evidence of the Divine goodness. He was burned at the stake in 1600; had he lived only ten years longer, his convictions would have been strengthened by Galileo's discovery of mountains and supposed seas on the moon.

The arguments of Kepler and Newton led to a general recognition that the stars were not other worlds like our earth but other suns like our sun. When once this was accepted it became natural to imagine that they also were surrounded by planets and to picture each sun as showering life-sustaining light and heat on inhabitants more or less like ourselves. In 1829 a New York newspaper scored a great journalistic hit by giving a vivid, but wholly fictitious, account of the activities of the inhabitants of the moon as seen through the telescope recently erected by His Majesty's Government at the Cape.

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[1] Afternoon lecture, Royal Institution of Great Britain, November 20, 1941.

It will be a long time before we could see what the New York paper claimed to see on the moon—bat-like men flying through the air and inhabiting houses in trees—even if it were there to see. To see an object of human size on the moon in detail we should need a telescope of from 10,000 to a 100,000 inches aperature, and even then we should have to wait years, or more probably centuries, before the air was still and clear enough for us to see details of human size.

To detect general evidence of life on even the nearest of the planets would demand far larger telescopes than anything at present in existence, unless this evidence occupied an appreciable fraction of the planet's surface. The French astronomer Flammarion once suggested that if chains of light were placed on the Sahara on a sufficiently generous scale, they might be visible to Martian astronomers if any such there be. If this light were placed so as to form a mathematical pattern, intelligent Martians might conjecture that there was intelligent life on earth. Flammarion thought that the lights might suitably be arranged to illustrate the theorem of Phythagoras (Euclid, I. 47). Possibly a better scheme would be a group of searchlights which could emit successive flashes to represent a series of numbers. If, for instance, the numbers 3, 5, 7, 11, 13, 17, 19, 23 . . . (the sequence of primes) were transmitted, the Martians might surely infer the existence of intelligent Tellurians. But any visual communication between planets would need a combination of high telescopic power at one end and of engineering works on a colossal, although not impossible, scale at the other.

Some astronomers—mainly in the past—have thought that the so-called "canals" on Mars provide evidence of just this kind, although of course unintentionally on the part of the Martians. Two white patches which surround the two poles of Mars are observed to increase and decrease with the seasons, like our terrestrial polar ice. Over the surface of Mars some astronomers have claimed to see a geometrical network of straight lines, which they have interpreted as an irrigation system of canals, designed to bring melted ice from these polar caps to parched equatorial regions. Percival Lowell calculated that this could be done by a pumping system of 4,000 times the power of Niagara. It is fairly certain now that the polar caps are not of ice, but even if they were, the radiation of the summer sun on Mars is so feeble that it could not melt more than a very thin layer of ice before the winter cold came to freeze it solid again. Actually the caps are observed to change very rapidly and are most probably clouds consisting of some kind of solid particles.

The alleged canals can not be seen at all in the largest telescopes nor can they be photographed, but there are technical reasons why neither of these considerations is conclusive against the existence of the canals. A variety of evidence suggests, however, that the canals are mere subjective illusions—the result of overstraining the eyes in trying to see every detail of a never very brightly illuminated surface. Experiments with school-children have shown that under such circumstances the strained eye tends to connect patches of color by straight lines. This will at least explain why various astronomers have claimed to see straight lines not only on Mars, where it is just conceivable that there might be canals, but also on Mercury and the largest satellite of Jupiter, where it seems beyond the bounds of possibility that canals could have been constructed, as well as on Venus, on which real canals could not possibly be seen since its solid surface is entirely hidden under clouds. It may be significant that E. E. Barnard, perhaps the most skilled observer that astronomy has ever known, was never able to see the canals at all, although he studied Mars for years through the largest telescopes.

A more promising line of approach to our problem is to examine which, if any, of the planets is physically suitable for life. But we are at once confronted with the difficulty that we do not know what precise conditions are necessary for life. A human being transferred to the surface of any one of the planets or of their satellites, would die at once and this for several different reasons on each. On Jupiter he would be simultaneously frozen, asphyxiated and poisoned, as well as doubly pressed to death by his own weight and by an atmospheric pressure of about a million terrestrial atmospheres. On Mercury he would be burned to death by the sun's heat, killed by its ultra-violet radiation, asphyxiated from want of oxygen and desiccated from want of water. But this does not touch the question of whether other planets may not have developed species of life suited to their own physical conditions. When we think of the vast variety of conditions under which terrestrial life exists on earth—plankton, soil-bacteria, stone-bacteria and the great variety of bacteria which are parasitic on the higher forms of life, it would seem rash to suggest that there are any physical conditions whatever to which life can not adapt itself. Yet, as the physical states of other planets are so different from that of our own, it seems safe to say that any life there may be on any of them must be very different from the life on earth.

The visible surface of Jupiter has a temperature of about $-138°$ C., which represents about 248 degrees of frost on the Fahrenheit scale. The planet probably comprises an inner core of rock, with a surrounding layer of ice some 16,000 miles in thickness, and an atmosphere which again is several thousands of miles thick and exerts the pressure of a million terrestrial atmospheres which we have already mentioned. The only known constituents of this atmosphere are the poisonous gases methane and ammonia. It is certainly hard to imagine such a planet providing a home for life of any kind whatever. The planets Saturn, Uranus, Neptune and Pluto, being further from the sun, are almost certainly even colder than Jupiter and in all probability suffer from at least equal disabilities as abodes of life.

Turning sunwards from these dismal planets, we come first to Mars, where we find conditions much more like those of our own planet. The average temperature is about −40° C., which is also −40° on the Fahrenheit scale, but the temperature rises above the freezing point on summer afternoons in the equatorial regions. The atmosphere contains at most only small amounts of oxygen and carbon dioxide, perhaps none at all, so that there can be no vegetation comparable with that of the earth. The surface, in so far as it can be tested by a study of its powers of reflection and polarization, appears to consist of lava and volcanic ash. To us it may not seem a promising or comfortable home for life, but life of some kind or other may be there nevertheless.

Being at the same average distance from the sun as the earth, the moon has about the same average temperature, but the variations around this average temperature are enormous, the equatorial temperature varying roughly from 120° C. to −80° C. The telescope shows high ranges of mountains, apparently volcanic, interspersed with flat plains of volcanic ash. The moon has no atmosphere and consequently no water; it shows no signs of life or change of any kind, unless perhaps for rare falls of rock such as might result from the impact of meteors falling in from outer space. A small town on the moon, perhaps even a large building, ought to be visible in our largest telescopes, but, needless to say, we see nothing of the kind.

Venus, the planet next to the earth, presents an interesting problem. It is similar to the earth in size but being nearer the sun is somewhat warmer. As it is blanketed in cloud we can only guess as to the nature of its surface. But its atmosphere can be studied and is found to contain little or no oxygen, so that the planet's surface can hardly be covered with vegetation as the surface of the earth is. Indeed, its surface is probably so hot that water would boil away. Yet no trace of water-vapor is found in the atmosphere, so that the planet may well be devoid of water. There are reasons for thinking that its shroud of clouds may consist of solid particles, possibly hydrates of formaldehyde. Clearly any life that this planet may harbor must be very different from that of the earth.

The only planet that remains is Mercury. This always turns the same face to the sun and its temperature ranges from about 420° C. at the center of this face to unimaginable depths of cold in the eternal night of the face which never sees the sun. The planet is too feeble gravitationally to retain much of an atmosphere and its surface, in so far as this can be tested, appears to consist mainly of volcanic ash like the moon and Mars. Once again we have a planet which does not appear promising as an abode of life and any life that there may be must be very different from our own.

Thus our survey of the solar system forces us to the conclusion that it contains no place other than our earth which is at all suitable for life at all resembling that existing on earth. The other planets are ruled out largely by unsuitable temperatures. It used to be thought that Mars might have had a temperature more suited to life in some past epoch when the sun's radiation was more energetic than it now is, and that similarly Venus can perhaps look forward to a more temperate climate in some future age. But these possibilities hardly accord with modern views of stellar evolution. The sun is now thought to be a comparatively unchanging structure, which has radiated much as now through the greater part of its past life and will continue to do the same until it changes cataclysmically into a minute "white-dwarf" star. When this happens there will be a fall of temperature too rapid for life to survive anywhere in the solar system and too great for new life ever to get a foothold. As regards suitability for life, the earth seems permanently to hold a unique position among the bodies surrounding our sun.

Our sun is, however, only one of myriads of stars in space. Our own galaxy alone contains about 100,000 million stars, and there are perhaps 10,000 million similar galaxies in space. Stars are about as numerous in space as grains of sand in the Sahara. What can we say about the possibilities of life on planets surrounding these other suns?

We want first to know whether these planets exist. Observational astronomy can tell us nothing; if every star in the sky were surrounded by a planetary system like that of our sun, no telescope on earth could reveal a single one of these planets. Theory can tell us a little more. While there is some doubt as to the exact manner in which the sun acquired its family of planets, all modern theories are at one in supposing that it was the result of the close approach of another star. Other stars in the sky must also experience similar approaches, although calculation shows that such events must be excessively rare. Under conditions like those which now prevail in the neighborhood of the sun, a star will only experience an approach close enough to generate planets about once in every million, million, million years. If we suppose the star to have lived under these conditions for about 2,000 million years, only one star in 500 million will have experienced the necessary close encounter, so that at most one star in 500 million will be surrounded by planets. This looks an absurdly minute fraction of the whole, yet when the whole consists of a thousand million million million stars, this minute fraction represents two million million stars. On this calculation, then, two million million stars must already be surrounded by planets and a new solar system is born every few hours. The calculation probably needs many adjustments; for instance, conditions near our sun are not at all typical of conditions throughout space and the conditions of to-day are probably not typical of conditions in past ages. But even so the calculation suggests, with a large margin to spare, that although planetary systems may be rare in space, their total number is far from insignificant. Out of the thousands or millions of millions of planets that there must surely be in space, a very great number must have physical conditions very similar to those prevailing on earth.

We can not even guess whether these are inhabited by life like our own or by life of any kind whatever. The same chemical atoms exist there as exist here and must have the same properties, so that it is likely that the same inorganic compounds have formed there as have formed here. If so, we would like to know how far the chain of life has progressed but present-day science can give no help. We can only wonder whether any life there may be elsewhere in the universe has succeeded in managing its affairs better than we have done in recent years.

THE MECHANISM OF SPECIES ADAPTATION TO CARCINOGENS

By Dr. R. R. SPENCER, Assistant Chief

AND

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INTRODUCTION

THAT the cancer cell is the result of a slow process of adjustment of normal cells to an unusual environment over a period of time embracing several or many cell-division cycles is the simple hypothetical basis upon which the experiments described herein were undertaken. The concept is not new, but as far as known, little if any experimental evidence has been produced in support of it. Therefore it was thought that some light might be thrown on the process of cancer induction by observing the behavior of small free-living organisms in the presence of carcinogenic agents over a considerable period of the racial history involving numerous successive generations.

We do not believe that the past experience of cancer investigators, either in the clinical or in the experimental fields, warrants the assumption that the genesis of a cancer cell involves a sudden change of a normal cell. All pathological entities barring those due to wounds and hereditary defects are the result of a process—a process of adjustment to an unusual or unfavorable environment. Cancer, we suspect, is no exception unless it be that the process here is slower than in most other diseases, and this slowness may be due in part to the fact that the genetic mechanism of the cell is primarily affected.

The clinically observed association of cancer with chronic irritation, the prolonged incubation period in experimentally induced cancer and the various precancerous lesions and stages that have been described, all seem to fit in with the concept of *gradualism* as a reasonable hypothesis in the genesis of cancer. The clinical examples of a step-like derivation of malignant growth does not exclude completely, of course, the alternative concept of a sudden mutational change as an occasional mechanism, for it is true that mutations can be induced experimentally with some of the same agents that are known to induce cancer and as the result of a single stimulus of great magnitude (x-rays, gamma rays of radium, heat). Such agents may either destroy one or more genes or disarrange the genic pattern and sequence. But in nature these highly artificial procedures are certainly the exceptions rather than the rule. It seems reasonable then to assume that a genetic change may be very frequently the culmination of a series of subliminal stimuli which have extended through many cell-divisions or generations.

The successful immunization of individual animals to multiple lethal doses of various toxins is well known, and can be achieved best by means of interval injections of increasing doses over a considerable period. Naturally one suspects that the permanent and successful adaptation of a race or species in contrast to the adjustment of the individual cell or organism would require a much longer time. However, it is believed that the underlying biochemical mechanism of species adaptation must of necessity be basically similar to the mechanism of adjustment of an individual organism.

For the past three years our experiments have been concerned with species adaptation of small organisms to carcinogenic agents. The results have led us to the suggestion that a cancer cell is a normal cell that has been able to make a more or less successful adjustment to an unusual environment—successful only from the standpoint of the cell itself. The adjustment is, of course, a fatal one from the standpoint of the organism as a whole. The continuous exposure of several widely separated species (bacteria, paramecia and worms) to such agents has yielded very different results. Nevertheless, there has been a certain consistency to which we now wish to invite attention and which we believe gives us a little better insight into the process by which species gradually become adapted to specific environments.

It is believed that the experiments here described yield convincing evidence that an individual can readily withstand an environment which will ultimately kill the species, provided the exposure is continued over a sufficient number of successive generations. In other words an environment which has no visible or measurable deleterious effect on individual organisms at first and in fact may display a stimulating effect for a number of generations will nevertheless finally weaken and in some cases destroy the species, provided the exposure is continuous.

A. RESULTS WITH BACTERIA

In our first experiment[1] a strain of bacteria (*Eberthella typhi*) was treated continuously with methylcholanthrene (1 mgm in 10 cc of medium) for 240 consecutive daily transfers.

Besides an initial stimulation of cell-division rate, the only definite change noted was that the amount of visible growth in the culture tubes of the latter end of the series (two-hundredth to the two-hundred and fortieth) was considerably less than in the tubes of the first part of the series or of any of the tubes of the control series, as determined by the degree of turbidity. This suggested a gradual weakening of the strain of organisms, since all tubes contained the same amount of plain broth from the same batch. In further support of this, it was also observed that a much larger amount of inoculum from the latter tubes of the methylcholanthrene-treated series (two-hundredth to two-hundred and fortieth tubes) was needed in order to obtain a good growth and distribution of colonies on agar slants, although at the time of transplantation these latter cultures were not as old and had been incubated (37° C) for a less number of days than those of the first part of the series. At that time, the experiment was thought to have yielded essentially negative results and so was discontinued. In the light of subsequent observations on paramecia, however, it is believed now that a further weakening of the strain would have been apparent had the experiment been continued.

B. RESULTS WITH PARAMECIA

A strain of *Paramecium multimicronucleatum* has been exposed continuously to methylcholanthrene (1 mg per litre of medium) since May 8, 1939, to the present writing—January, 1942. Cultures have been transferred every ten days. For the first 20 to 30 transfers neither structural nor functional differences could be noted between the organisms in the control and in the methylcholanthrene-adapted series.

From the thirty-fifth to the forty-fifth transfer, however, a striking increase in the viability of the methylcholanthrene-treated organisms was apparent. The details of these tests have also been reported.[2]

Still later in the process of adaptation to methylcholanthrene (fiftieth to seventy-fifth transfer) the organisms displayed a further change in their behavior. At this time they had acquired the ability to reach population levels far higher than control organisms which at all periods throughout the more than 2-year adjustment period have displayed a fairly constant functional pattern as measured by our viability tests.[3]

The exposure of paramecia to methylcholanthrene has now reached the eightieth transfer and the organisms are displaying a loss of their former toughness and a decrease in their ability to reach high population levels. Repeated tests now indicate that they are far weaker than the corresponding unexposed control organisms. Structural changes have not been observed. The process of adjustment is being continued.

Paramecia exposed to the noncarcinogen but closely related polycyclic hydrocarbon phenanthrene in the same concentrations (1 mg per litre) multiplied for 3 transfers and the organisms were not apparently affected but the fourth transfer died. As a rule, we have found noncarcinogens more toxic than carcinogens. In our experience, untreated controls have always survived upon transfer and are as vigorous now on the ninetieth transfer as they were at first.

Paramecia were also exposed continuously to eosin in 10 separate series of dilutions graded from 1–1,000 to 1-10,000. The organisms exposed to 1-10,000 eosin have grown and multiplied continuously for 85 ten-day transfers over a period of 2 years and 9 months. They have gradually become smaller in size than the control series, and this eosin-treated strain is slowly losing its vigor as measured by our viability tests referred to above. In fact, the organisms in the 1-1,000, 1-2,000 and 1-3,000 series thrived for 18 transfers, but it was not possible to make successful transfers afterward. Thus the strain was destroyed by long and continuous exposure to an environment which did not at first affect individuals in any measurable way.

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[1] R. R. Spencer and M. B. Melroy, *Jour. Nat. Cancer Inst.*, 1: 129–134, 1940.

[2] *Idem, Jour. Nat. Cancer Inst.*, 1: 343–348, 1940.

[3] *Idem, Jour. Nat. Cancer Inst.*, 2: 185–191, 1941.

C. Results with a Species of Worm

Confirmatory and perhaps more convincing results have been obtained with a small flat worm, *Stenostoma tenuicaudatum*. The methods and details of this experiment will be published later. This species was exposed continuously to methylcholanthrene, to phenanthrene and to the gamma rays of radium (33 mg). At the same time a continuous series of untreated control cultures were carried. Transfers were made every 14 days. Each transfer consisted of 12 worms. Population counts were made on the forty-fifth day after transplantation. The methylcholanthrene-treated worms maintained consistently higher population levels over a period of 30 transfers (March, 1940, to May, 1941). This series has now (January, 1942) been transferred 43 times. Since the thirtieth transfer the populations have sometimes been above and sometimes below the control. The adjustment process is being continued.

The phenanthrene-treated series of worms, however, thrived for eight transfers, reaching much higher levels than the controls on the sixth transfer. The worms in the ninth culture dish of this series died. To prove that there was no substance in this dish fatal to the worms, twelve untreated control worms were added to it. They multiplied readily.

The same phenomenon was manifested with a series of worm cultures irradiated continuously with 33 mg of radium. The worms thrived in the presence of radium for nine transfers. On the seventh transfer the population was higher than the corresponding control or that of any of the other treated series. In the eighth and ninth culture of the series, however, the number of worms was greatly reduced. For this reason, the amount of radium was reduced from 33 to 23 milligrams. From the tenth to the twenty-second culture the worms again grew well and the populations remained sometimes above and sometimes below those of the control series. After the twenty-second culture, the populations of each successive dish diminished. All died on the thirtieth transfer. Thus it seemed that radiations from radium which manifested no deleterious effects on the individual worms of the first eight transfers were able later to destroy the species at the thirtieth transfer, even though the intensity of the irradiation was decreased at the tenth transfer.

Discussion

It is believed that the above-outlined tests suggest the existence of a cumulative effect upon a species exposed *continuously* to an unusual environment covering many cell-division cycles or generations. These experiments have also suggested to us that an alternating or rhythmic rather than a continuous exposure of a species to a harsh environment may yield more interesting and perhaps more significant results—results that may shed further light on the basic principles of species adaptation. In fact, recently inaugurated experiments in which bacteria have been exposed to unfavorable agents already have shown that such organisms can resist and adapt to much harsher environments when the exposure is rhythmic than when it is continuous. It may be that a period of rest and recuperation is necessary to the successful adjustment of all living things regardless of whether we have in mind a species or an individual of the species. Rhythmicity is an almost universal phenomenon in nature, but not many biological experiments have been devised to study the effects of a rhythmic exposure to unfavorable conditions.

In this connection it is recalled that Magoon,[4] of the U. S. Bureau of Plant Industry, showed that, contrary to the commonly accepted idea that bacterial spores once formed have a fixed resistance, have in reality a resistance which varies with age and with the conditions under which the spores exist. He was able to demonstrate that bacterial spores of *B. mycoides* derived from heat-resistant survivors in thermal death time tests possessed higher resistance to heat than the original spores and by a process of selection, a strain of bacteria was obtained whose spores attained a resistance to heat at least 25 times that of the original spores. Magoon was interested in determining the heat necessary to destroy spore-bearing organisms in canned goods.

Armstrong,[5] of the U. S. Public Health Service, attempted to develop a vaccine virus that would keep at room or body temperatures. He exposed the virus to incubator temperature (37.5° C.) and by continued selection and propagation of the virus in the rabbit was able to develop a strain which showed an "increase of several hundred per cent. in the period of time during which it will withstand a temperature of 37.5° C. and still give typical skin takes on rabbits." A notable increase in the virulence of the virus for animals was also noted, and this feature deterred him from employing the strain in man.

[4] C. A. Magoon, *Jour. Inf. Dis.*, 38: 429-439, 1926.

[5] C. Armstrong, *Pub. Health Rep.*, 44: 1183-1191, 1929.

Neither Magoon nor Armstrong mentioned the principle of rhythmic exposure to an unfavorable environment as a possible factor of broad application in the study of the mechanism of species adaptation, although their technique involved this principle.

Huntington[6] is the only investigator of whom we are aware who has presented data and observations emphasizing the importance of an alternating environment. Huntington's thesis is that the highest human civilizations have arisen only in areas where there was an alternating climate. Continuously hot or continuously cold climates are enervating. A changeable climate is stimulating. A thorough search of the biological literature may reveal other examples that, in the light of our experiments, may now suggest the general biological importance of rhythmic exposure to unfavorable environments.

SUMMARY

(1) Three widely separated species have been exposed *continuously* to carcinogenic and other agents over a considerable period of time and throughout many cell-division cycles.

(2) Evidence is presented to show that each of these species may be weakened and in some cases destroyed when exposed to amounts of these unfavorable agents which have no measurable deleterious effect on individual organisms, but which may in some cases at first be stimulating. The biological generalization that certain environments may be ontogenetically harmless but phylogenetically lethal is suggested.

(3) Preliminary tests suggest also that a *rhythmic* rather than a *continuous* exposure of a species to harsh environments may be a very useful technic to employ in the study of the mechanism of species adaptation.

OBITUARY

SIR WILLIAM BRAGG

ON Thursday, March 12, in the passing of Sir William Bragg, death robbed physics of one of its most illustrious ornaments and all science of one of its best loved friends.

In an age when so much of discovery falls to the lot of youth, it is a comfort to ponder the cases in history which stand as proof that middle age does not always spell the death of originality and that maturity provides its own special seasoning in the realms of discovery, a seasoning which science would miss greatly were it deprived of it. Sir William Bragg stands as an example of rich development in years in which the prime of youth has passed; for though, naturally, he was a successful student and an eminently successful teacher, it was not until eighteen years after his departure from Cambridge to accept the professorship of mathematics and physics at the University of Adelaide that he published his first paper when he was more than 40 years old. It is very evident, however, that in the years which had preceded, there had been a great strengthening of mental forces to the point of readiness for service when once released in the search for new truth, for within three years of his first publication he had become a fellow of the Royal Society, and from that time onwards he was a continual contributor to the journals of science.

Bragg's first paper on the range and ionization of alpha particles is one of the fundamental stepping-stones in the science of radioactivity, and he continued to contribute richly to that field, partly in collaboration with Kleeman. In 1908 he returned to England as professor of physics at the University of Leeds, and it was not long before he became interested in x-ray research, coming into that field at a time when, with the principles of the quantum theory knocking at the doors of science, conventional electromagnetic views as to the behavior of nature held powerful sway in the halls of learning. Bragg was a strong advocate of the particle nature of x-rays and, while none can doubt the broadness of his concepts of the nature of what was then termed a particle, his natural desire for simplicity of expression caused his writings to take a form which invited considerable controversy with the extreme opposed school, represented prominently at the time by C. G. Barkla, who desired to retain classical electrodynamics in as pure a form as possible. It is characteristic of Bragg's broadness of view and his adaptability to changing pictures that, following von Laue's fundamental discovery in x-ray diffraction, he entered that field with enthusiasm and, in collaboration with his son, William Lawrence Bragg, became the most prominent worker in the field which established the science of x-ray spectroscopy. He was at Leeds when the war of 1914–18 broke out, but he became professor of physics at University College, London, in 1915. Most of his time during the war was devoted to government work and he became director of the Royal Institution and the Davy-Faraday Research Laboratory in 1923. In this position his powers reached their maximum field of usefulness. Endowed with all the personal charm so essential to the office, he was a worthy successor to Faraday, not only as a fruitful investigator, but also as an inspiring speaker possessed of a gift for lucidity which made his lectures a joy, both to the man of science and to the layman.

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[6] Ellsworth Huntington, "Civilisation and Climate." Yale University Press, 1922.

Bragg was keenly interested in the history of the Royal Institution and in the work of his great predecessor, Michael Faraday. He played a very prominent part in the publication of Faraday's diary and was responsible for bringing about a very delightful occasion when at the institution—the centenary of Faraday's discoveries, which was celebrated in 1931.

Sir William Bragg was born on July 2, 1862, at Wigton, Cumberland, England. In Adelaide he married Gwendoline, daughter of Sir Charles Todd, and had three children, Sir Lawrence Bragg, now at the University of Cambridge, Gwendy, now Mrs. Alban Caroe, and Robert. He was the recipient of many honors, among them the Order of Merit, the Nobel Prize for physics, the Rumford and Copley Medals, the Barnard Medal of Columbia University, and the Franklin Gold Medal of the Franklin Institute. He served as president of the British Association for the Advancement of Science and from 1935–40 was president of the Royal Society of London.

Sir William was noted for his kindly disposition and his courtesy to all. He had a simplicity of manner which endeared him both to his intimate colleagues and to those whom he met casually. Death has dealt heavily with physics during recent years. First Lord Rutherford, then his old professor, Sir J. J. Thomson, next the oldest of them all, Sir Oliver Lodge, and, finally, Sir William Bragg have been gathered to the halls of the illustrious dead. It is a grand and noble company which thus carries to Valhalla the records of achievement of the most fruitful epoch in the whole history of science.

W. F. G. SWANN

BARTOL RESEARCH FOUNDATION OF THE
FRANKLIN INSTITUTE,
SWARTHMORE, PA.

DEATHS AND MEMORIALS

DR. WILLIAM LOGAN BENITZ, since 1896 professor of mechanical engineering at the University of Notre Dame until his retirement with the title emeritus in 1939, died on June 1. He was sixty-nine years old.

DR. JOSEPH HYDE PRATT, consulting engineer and geologist, from 1904 to 1926 professor of economic geology at the University of North Carolina and from 1905 to 1924 state geologist, died on June 2, at the age of seventy-two years.

DR. DONALD FRANCIS MACDONALD, consulting geologist for the Panama Canal Zone, formerly professor of geology at St. Francis Xavier University, Nova Scotia, died on May 29 in his sixty-seventh year.

DR. MILLARD MANNING, assistant professor of physics at the University of Pittsburgh, died on June 1, at the age of thirty-six years.

THE REV. DR. THEODORE EVELYN REECE PHILLIPS, rector of Headley, Epsom, from 1916 to 1941, a past president of the Royal Astronomical Society and the British Astronomical Association, died on May 13, at the age of seventy-four years.

DR. G. G. STONEY, consulting engineer, from 1917 to 1926 professor of mechanical engineering in the College of Technology and in the Victoria University, Manchester, from 1926 to 1930 director of research at C. A. Parsons and Company, died on May 15 in his seventy-ninth year.

TAU CHAPTER of Nu Sigma Nu at Cornell University Medical College has voted to name its annual lectureship for Walter L. Niles, dean of the college for many years and at the time of his death in December, 1941, acting dean. A fellowship in the department of medicine at Cornell also has been established in Dr. Niles's memory.

SCIENTIFIC EVENTS

DRUG CONTROL IN INDIA

Nature gives an account of progress in the problem of drug standardization and control in India.

In January, 1937, the nucleus of a central laboratory, the Biochemical Standardization Laboratory, was established, under the direction of Sir R. N. Chopra, in Calcutta, at the All-India Institute of Hygiene and Public Health. The laboratory has now made satisfactory progress in the limited number of studies undertaken and has trained adequate personnel and laid sure foundations for future work in this field as evidenced in the triennial report of the laboratory. During the three years preceding the introduction of the Drugs Bill in February, 1940, it was thought that the best course for the laboratory was to undertake a general survey of the quality of medical drugs in the Indian market and an examination of the specimens of drugs both imported and manufactured in India which were suspected to be of inferior quality.

Many drug manufacturing firms in India do not maintain properly equipped pharmacological laboratories with trained personnel capable of undertaking the standardization of chemotherapeutic preparations, and it was natural that ethical manufacturing concerns interested in the quality of their products should approach the only government organization available with requests to have their products standardized.

In the initial stages the laboratory had necessarily to restrict itself to certain definite drugs of comparatively greater importance to the pharmaceutical and medical professions. Routine analytical work was therefore largely concentrated on surveying the quality of tinctures of digitalis, strophanthus and squills, extract of posterior pituitary gland and adrenaline hydrochloride solution. In addition to the routine activities a good deal of interest in research problems on subjects which have a direct or indirect bearing on drug work was consistently maintained. For example, one of the first group of drugs which the laboratory investigated was the cardiac drugs of the digitalis series. Liquid preparations of these drugs deteriorate at a fairly rapid rate when stored under the climatic conditions existing in India, and factors leading to this deterioration and loss of potency have been the subject of investigation. Again, the estimation of the antidiuretic potency of pituitary extract in rats was given an extensive trial and found to be quite reliable and to compare favorably with the results obtained by the oxytocic method. In addition, the laboratory has the responsibility of acting as the national center for the maintenance and distribution of certain international surgical standards.

CONSERVATION AND SOUTH AMERICAN EXPEDITIONS

Two projects are announced by the National Park Service, whereby this agency will cooperate in encouraging mutual understanding of conservation problems between the Americas.

A combined plant-hunting expedition and lecture tour in South America is being undertaken by Dr. T. Harper Goodspeed, director of the Botanical Garden at the University of California and a collaborator of the National Park Service. His expedition is a joint project in which the University of California and South American institutions are cooperating. Well known to both continents, because of two other scientific trips to South America in 1935–36 and 1938–39, and author of the recently issued book, "Plant Hunter in the Andes," Dr. Goodspeed has been invited to lecture in Spanish and Portuguese in Argentina, Brazil, Chile, Colombia, Peru and Uruguay. His lectures will include color motion pictures of the National Parks of western United States and deal with wildlife conservation.

A Roosevelt Fellowship for study in South America has recently been awarded to Julian Vogt, ranger naturalist successively in six western National Parks. This traveling fellowship of the Institute for International Education was established by the Office of the Coordinator of Inter-American Affairs, which has financed the project. Ten United States students have been awarded these exchange fellowships, and one student in each of the twenty other American republics. In announcing the project, the coordinator, Nelson Rockefeller, stated:

> The 21 American republics confidently face the future together, during the war and after. The scholarship program which the American republics have jointly arranged affords another strong bond to assure the cooperation essential to victory and stable peace.

Mr. Vogt, a graduate of the University of California, will study at the University of Buenos Aires, concentrating on South American policies of conservation. He will also visit the National Parks and reservations of various countries in South America.

THE FLORA OF CUBA

BROTHER LÉON (Joseph Sylvestre Sauget y Barbier), for many years a professor on the staff of the Colegio de la Salle, Vedado, Havana, Cuba, has received a special grant from the Milton Fund, Harvard University, to be utilized by him in preparing for publication a comprehensive work on the flora of Cuba.

Throughout his long residence in Cuba, Brother Léon has devoted a large amount of time to accumulating data on the flora of Cuba, and from his wide experience is eminently fitted to consummate the task to which he has set his hand. Some years ago, in recognition of his accomplishments as a botanist, he was the recipient of an honorary doctorate of science from Columbia University.

Brother Léon was appointed as collaborator on the staff of the Atkins Institution of the Arnold Arboretum, Harvard University, in 1938, in appreciation of his botanical accomplishments. In furtherance of the cooperative work on the flora of Cuba between Harvard and other institutions, may be mentioned the recently published, copiously illustrated volume of 496 pages by Brother Léon and Brother Marie-Victorin, entitled "Itinéraires botaniques dans l'île de Cuba," issued in 1942 by the Botanical Laboratory of the University of Montreal. Publication was made possible through a subvention to the University of Montreal, through the Atkins Institution. The Milton Fund grant to Brother Léon is further evidence of interest in this field of international cooperation. It is the first time that a grant from this fund has been made available for expenditure through an institution outside of the United States, thus forming an excellent illustration of inter-American collaboration.

NEW YORK CHAPTER OF THE SCIENCE SOCIETY OF CHINA

A NUMBER of Chinese scientists in New York City have joined in forming an organization known as "The Science Society of China, New York Chapter." This society was organized originally at Cornell University in 1914 and later was established in China in

1918. Its object is to promote better understanding and cooperation among the Chinese research workers in the United States of America in order to contribute to the advancement of the various branches of science, both natural and social.

The activities of the society for the present consist in promoting lecture meetings for scientific discussions at which distinguished speakers will address the meeting.

The officers of the society have been elected as follows:

President: John Y. C. Watt, Cornell University Medical College.
Vice-president: Chek M. Soo-Hoo, Presbyterian Hospital, New York City.
Secretary: Roberta Ma, New York Botanical Garden.
Treasurer: Raymond Yoh, Bank of China, New York City.
Members of the Committee: Katherine Li, Memorial Hospital, New York City; Min Pung Tien, Columbia University; Van Y. S. Hong, Syracuse University.

THE AMERICAN COMMISSION ON SCIENTIFIC NOMENCLATURE IN ENTOMOLOGY

THE disturbed condition of the world during the last few years has interfered with the activities of the International Commission on Zoological Nomenclature, and there is no prospect that this commission will again function successfully for several years to come. Entomologists in the United States have felt that this situation should not be allowed entirely to stifle progress in the development of nomenclature and the clarification of nomenclatorial problems. At the meetings of the Entomological Society of America and the American Association of Economic Entomologists in San Francisco, in December, 1941, a plan was adopted which called for the establishment of an American Commission on Scientific Nomenclature in Entomology.

In accord with the terms of this plan, C. F. W. Muesebeck and Professor G. F. Ferris were appointed to organize the commission. That organization has now been completed and the commission is ready to function. It includes Professor J. C. Bradley, of Cornell University; W. J. Brown and G. Stuart Walley, of the Division of Entomology of the Department of Agriculture of Canada; Professor G. F. Ferris, of Stanford University; Professor T. H. Hubbell, of the University of Florida; Professor H. B. Hungerford, of the University of Kansas; Dr. E. G. Linsley, of the University of California; Professor Clarence E. Mickel, of the University of Minnesota; C. F. W. Muesebeck and P. W. Oman, of the U. S. Bureau of Entomology and Plant Quarantine; Professor A. G. Richards, Jr., of the University of Pennsylvania; Dr. Herbert H. Ross, of the State Natural History Survey of Illinois; Professor C. W. Sabrosky, of the State Agricultural College of Michigan; Dr. R. L. Usinger, of the College of Agriculture of California. Professor G. F. Ferris has been elected as chairman.

The commission will receive, consider and advise upon such nomenclatorial problems as are presented to it. All acts of the commission will be in harmony with the International Rules of Zoological Nomenclature, although recommendations for the clarification, extension and improvement of these rules may be made. The commission will report to the two parent societies at their next annual meeting. Communications concerning matters within the province of the commission may be addressed to any of its members.

G. F. FERRIS

MEETING OF EXPERIMENTAL BIOLOGISTS IN OREGON

A MEETING of experimental biologists was held at Portland, Oregon, on May 9.

Forty-seven workers from colleges and universities in the States of Oregon and Washington attended the meetings, during which papers were presented on varied subjects ranging from plant and animal physiology to ecology, embryology and genetics, and so forth.

The meeting was organized as the result of a general agreement as to the need for some annual meeting at which biologists interested in experimental work in the Pacific Northwest could get together. Held at Reed College, the program of papers was followed by a dinner at which the subject of the future organization of the group as well as the need for a general biological society in the region was discussed.

It was agreed that for the time being, at least, the organization should remain informal, though with the papers limited to the experimental fields, and that it should remain affiliated with no existing society or institution. It was agreed that the diversity of the subjects in the program as well as the general informality of the meeting were factors contributing to its success.

Dr. Orlin Biddulph, plant physiologist of the State College of Washington, was elected to head a committee to organize a similar meeting in the spring of next year.

SCIENTIFIC NOTES AND NEWS

COLUMBIA UNIVERSITY conferred on June 2 at its 188th commencement exercises the doctorate of science on Dr. Jekuthiel Ginsburg, professor of mathematics and head of the department at Yeshiva College; on Dr. Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania; on Dr. Robert

R. Williams, chemical director of the Bell Telephone Laboratories, and on Dr. Roger John Williams, professor of chemistry at the University of Texas.

The doctorate of laws was conferred on June 2 at the commencement exercises of the University of Pennsylvania on Dr. Vannevar Bush, president of the Carnegie Institution of Washington and director of the Office of Scientific Research and Development.

The doctorate of science was conferred by Ohio Wesleyan University, at the recent centennial exercises, on Dr. Arthur Bevan, of the class of 1912, State Geologist of Virginia since 1929.

Park College on May 25 conferred the honorary doctorate of science on Dr. Ross A. McFarland, of Harvard University, who gave the commencement address. The honorary degree of doctor of laws was conferred on Dr. Paul Prentice Boyd, professor of mathematics and dean of the College of Arts and Sciences of the University of Kentucky.

At the commencement exercises of the Michigan College of Mining and Technology, honorary degrees were conferred on the commencement speaker, Dr. Robert C. Wallace, and on Harlan S. Emlaw, mining engineer and industrial leader, of New York City, of the class of 1895. Dr. Wallace is principal of Queen's University, Kingston, Ontario, and has served as president of the Canadian Institute of Mining and Metallurgy.

Middlebury College, at its commencement on May 25, conferred on Dr. James Montrose Duncan Olmsted, professor of physiology at the University of California, the degree of doctor of science. Dr. Olmsted gave the Phi Beta Kappa address on "The Place of Physiology in a University Curriculum."

The Duddell Medal of the Physical Society, London, which was awarded to Dr. William David Coolidge in recognition of his pioneer work in the production of ductile tungsten and of his invention and the subsequent development of the hot-cathode high-vacuum x-ray tube, was formally presented to him on May 1 by Viscount Halifax, British Ambassador to the United States, at a dinner of the American Physical Society at Baltimore.

The Cornelius Amory Pugsley Gold Medal of the American Scenic and Historic Preservation Society was presented on June 2 to Harold L. Ickes, Secretary of the Department of the Interior.

Dr. Esther Carpenter, assistant professor of zoology at Smith College, has been awarded the Elizabeth Clay Howald scholarship of the Ohio State University for the coming year. The scholarship, carrying an annual stipend of $3,000, was endowed by the late Ferdinand Howald, in memory of his mother, and goes each year to "a person who has shown marked ability in some field of study and has in progress work the results of which promise to constitute important additions to our knowledge."

Dr. Edward Adler has been awarded the Author's Prize of $100 by the Electrochemical Society for the best paper of the year 1941, published in the *Transactions* of the society.

Dr. J. B. Collip, head of the department of biochemistry of McGill University, was elected on May 30 to succeed Judge F. W. Howat, of New Westminster, B. C., as president of the Royal Society of Canada.

Newly elected officers of the Sigma Xi Club of the University of Tennessee are Dr. Samuel L. Meyer, botany, *President;* Dr. Edgar D. Eaves, mathematics, *Vice-president;* and Dr. Samuel H. Winterberg, soil chemistry, *Secretary-Treasurer.*

At the meeting of the American Branch of the International League against Epilepsy, held in Boston on May 18, the following officers were elected: *President,* Wilder G. Penfield, Montreal; *Vice-president,* Charles D. Aring, Cincinnati; *Secretary-Treasurer,* Frederic A. Gibbs, Boston.

Dr. John Bitting Smith Norton, of the University of Maryland, having reached the retirement age, was made on April 1 professor emeritus in the departments of plant pathology and botany. Officers of the department of botany honored Dr. and Mrs. Norton at a banquet on April 7, when he was presented with tokens of esteem by his colleagues and former students. He will continue work on the university botanical herbarium and will carry on projects in plant breeding and taxonomy.

Dr. Charles Brooks, plant pathologist of the U. S. Department of Agriculture, who was retired on April 30, has accepted a research position with the Brogdex Company, of Pomona, Calif.

Dr. William R. Work, since 1921 head of the department of electrical engineering at the Carnegie Institute of Technology, Pittsburgh, has been appointed assistant director of the College of Engineering.

Dr. C. E. F. Guterman, assistant director of the Agricultural Experiment Station at Cornell University, has been made director of the station.

Dr. Alfred C. Reed has resigned as professor of tropical medicine at the University of California, and has become associate clinical professor of medicine at the Stanford University Medical School.

Dr. George D. Stoddard, head of the department of psychology, dean of the Graduate College of the State University of Iowa and director of the Iowa Child Welfare Research Station, will take up his work as New York State Commissioner of Education on July 1.

Dr. William Otis Hotchkiss, since 1935 president of the Rensselaer Polytechnic Institute, has been made assistant director general of the Army Specialist Corps.

Adolph G. Rosengarten, Jr., has resigned as director of Merck and Co., Inc., Rahway, N. J., because of duties with the Army, and is succeeded by his uncle, J. G. Rosengarten, Jr.

It is reported in the London *Times* that Dr. C. K. Mingle has been released from the U. S. Department of Agriculture at Washington to cooperate with British scientific men in the prevention of contagious abortion, a disease which, it was estimated just before the war, cost Great Britain more than £10,000,000 a year through reduced milk production and loss of cattle.

Dr. Alfred C. Kinsey, Indiana University, is in charge of the research project on human sex behavior for which the Committee for Research on Problems of Sex of the National Research Council has made a grant of $7,500 for use during the coming year. The research program has been under way for four years. During the past year, it was supported jointly by Indiana University and a grant from the National Research Council. Clyde E. Martin and Glenn Ramsey are collaborators in the research.

The commencement address at Rutgers University was delivered by Dr. Cecilia Payne Gaposchkin, astronomer at the Harvard College Observatory.

Dr. Melville J. Herskovits, of Northwestern University, who is at present engaged in anthropological field-work in Brazil, on May 6 delivered an address inaugurating the educational activities of the newly formed faculty of philosophy of Bahia.

A psychological examiner is being sought by the Los Angeles County Civil Service Commission to use psychological tests and other clinical techniques in the study of juveniles, and to make interpretations and recommendations on the basis of the tests given. University graduates, aged from 21 to 55 years, with a Ph.D. in psychology and 500 hours of clinical experience, or a master's degree in psychology and 1,000 hours of clinical experience, should file applications at 102 Hall of Records in Los Angeles on or before June 19.

Dr. Lloyd W. Fisher, of Bates College, writes that it seems inadvisable to conduct the New England Intercollegiate Geological Excursion in the autumn. It has also been suggested that no trips be held for the duration of the war.

The Brush Foundation, which is affiliated with the Western Reserve University School of Medicine, has received from an anonymous donor a gift of $250,000 to be used for the research and educational work of the foundation under the supervision of Dr. William Walter Greulich, director of the Brush Foundation and professor of physical anthropology and anatomy in the School of Medicine.

The Committee on Scientific Research of the American Medical Association has made the following grants: Barnett Sure, University of Arkansas, vitamin B complex; Paul Thomas Young, University of Illinois, appetite and food preferences in the rat; Deborah V. Dauber, Michael Reese Hospital, Chicago, atherosclerosis in the chick (Jay Conger Davis Research Fund); Milton Mendlowitz, Mount Sinai Hospital, New York, digital circulation (Jay Conger Davis Research Fund); Jacob Rabinovitch, Jewish Hospital of Brooklyn, effect of heparin on thrombosis; and Robert W. Virtue, University of Denver, sulfur metabolism in cystinuric dogs.

An Associated Press dispatch from Calcutta dated May 19 states that fifteen physicians and scientific men of the U. S. Public Health Service mission, who directed malaria control and sanitation for approximately 200,000 workers on the Yunnan-Burma Railway, escaped from territory overrun by the Japanese and are awaiting reassignment in India. The mission, headed by Dr. Victor H. Haas, of Memphis, Tenn., had been working since October in the southernmost 300 miles of the 700-mile route which was to link Kunming with Lashio to speed defense supplies to China. William Jellison, of Hamilton, Mont., and Henry A. Johnson, sanitary engineer, of Memphis, saved $5,000 worth of microscopes and other scientific apparatus when they left Yun Hsien.

The new research laboratories of the Overly Bio-Chemical Research Foundation, at 254 West 31st Street, New York City, are nearing completion. The foundation has recently been incorporated under the laws of the State of New York as a non-profit research organization which for the duration of the war will devote its work to problems of interest to military medicine, and which later on will deal with fundamental problems in biochemistry. The staff includes Dr. Kurt G. Stern, protein research chemist, formerly of the Yale Medical School; Dr. Arthur L. Schade, bacteriologist; and James S. Wallerstein, biological chemist, who is also president of the foundation. The scientific policies of the foundation are determined by a board of scientific directors whose members include Dr. Dean Burk, of the National Institute of Health; Dr. Leo Edelman, Dr. Leo Stieglitz and Dr. O. Alan Rose, all of New York City.

ACCORDING to the *Experiment Station Record*, a grant of $150,000 from the General Education Board for the conduct of a five-state regional study of land tenure and farm labor problems has been announced at the University of Arkansas. The university has been designated as fiscal agent. The research will include field studies of land tenure and farm labor problems in Arkansas, Mississippi, Louisiana, Texas and Oklahoma. A regional staff, headed by Dr. H. C. Hoffsommer, professor of rural sociology and sociologist at Louisiana State University and Station, will be employed, and a regional research laboratory will be set up at the university on a three-year basis. The project will be under the direction of the southwestern land tenure research committee, of which Dr. C. O. Brannen, head of the department of rural economics and sociology and assistant director of research, is chairman.

THE American Coordinating Committee on Corrosion is planning a revision of its confidential Directory of Technologists actively engaged in studies on corrosion and its prevention. The committee comprises delegates from the seventeen major technical societies together with representatives from the principal industrial research institutes and the National Bureau of Standards. Its directory lists some four hundred investigators in corrosion-preventive fields, selected on the basis of questionnaires circulated to the member societies of the committee. It requests that all those actively engaged in corrosion researches who have not received applications for information from the committee write to the secretary, Dr. G. H. Young, 4400 Fifth Avenue, Pittsburgh, Pa., for further details and application forms for directory listing.

DISCUSSION

SOIL FERTILITY AND MANURING IN CHINA

BEGINNING in 1935, the Soils and Fertilizers Department of the National Agricultural Research Bureau has been investigating the fertility of the soils of China, with especial reference to the limiting effect of plant food deficiencies, and to the possibility of increasing crop production by the use of fertilizers. The investigation is based in the first place on field experiments, chiefly "NPK Tests" consisting of modern factorial designs at two and/or three levels. The standard rate of application throughout is 8 *catties* per *mou* (about 0.5 cwt./acre), of N, P_2O_5 and K_2O. The experimental crops are rice, wheat, maize, rapeseed, cotton, millet, barley, sugar cane, Irish and sweet potatoes and mulberries (chiefly the first five). The experiments have been carried out either by this department directly, or in cooperation with provincial institutes, universities and other organizations. The field experiments are supplemented by laboratory, chemical tests for "available" nutrients in the soils of the experiments.

The results of over 170 of these field experiments, widely scattered through fourteen provinces of China, are now available. The work is still continuing, and yield results already obtained are still being analyzed, but although the investigation is thus incomplete, it is desired to put the broad results on record, in case the work should be interrupted. It is realized that the number of experiments is not large, in relation to the area covered (a consequence of the difficult conditions which have existed here since 1937), but none the less the general results are quite consistent within the various regions or soil groups, and it is believed that further extension of the work will not greatly alter the picture. It is thought that the findings will have some general interest to agriculturists and geographers, while the implications are important for the future of China.

Eighty-three per cent. of the soils tested in the field experiments gave significant responses to one or more nutrients: in other words, soil fertility is likely to be limited by plant food deficiencies in at least four fifths of the soils of China. (Early statements about the high fertility of Chinese soils were usually based on a superficial acquaintance with the rich soils of alluvial plains and deltas; much of interior China consists of relatively poor, hilly land.) Nitrogen deficiency was most general (74 per cent. of the soils); next came phosphate deficiency (38 per cent.); potash deficiency was uncommon (12 per cent.), probably because of the general use of ashes and local manures. There were clear relationships between the Great Soil Groups (as described by James Thorp), and nutrient supply or deficiency, which there is not space here to set out in detail. Briefly, the pedocal soils of north China (J. Lossing Buck's Wheat Region) were often deficient in nitrogen, but they were generally well supplied with phosphate and potash; the pedalfer soils of central and south China (Buck's Rice Region) were still more deficient in nitrogen, often seriously deficient in phosphate and sometimes deficient in potash. The red and yellow earths were the most seriously nutrient-deficient soil groups, and those on which fertilizers were most strikingly effective in increasing yields.

Estimates were made of the probable extent to which crop production could be increased in China, by using artificial fertilizers in addition to the present supplies of local manures and fertilizers (which can not be much expanded). If artificial fertilizers were used only on soils where they were likely to be needed (on the soils which gave significant responses in these experiments), it would be possible to increase the total production of crops in China by between one third and one half, using the rates of application mentioned above. (The variability of the estimate depends on the weights to be applied to different crops and regions.) This estimate may be taken as applying to the part of China covered by Buck's "Land Utilization in China," with the exclusion of his Spring Wheat Area. The increase in production would be much greater in the Rice Region (about one half increase over present production) than in the wheat region (about one fifth increase).

Taking economic factors into consideration, and using the 1937 farm prices in east and north China as a basis, it can be said that if all farmers whose soils needed fertilizer applied what was necessary, at the standard rate, then on the average individual farmers would have a two-to-one chance of making a profit (*i.e.*, one farmer out of three would be likely to lose money). If only those farmers applied fertilizer whose soils were likely to give an economic response, on the basis of the field experiments, total crop production in China could still be increased by at least *one quarter.* Supposing that China developed her own fertilizer industry and that fertilizers could be sold at prices comparable with those in the United States in 1937, then these estimates would be considerably increased. If all farmers with deficient soils used the necessary fertilizers, then each farmer would have at least a five-to-one chance of making a profit from his expenditure; if only those farmers used fertilizers who were likely to secure an economic response, total crop production in China could be increased by at least one third.

The bearing of these results on the population, food and economic problems of China needs no emphasis. While it may not be possible to take much action on them under present conditions, for the future they are equivalent in increased production to adding four or five new provinces to the 17 or 18 provinces for which these estimates may be expected to hold good. In connection with the reclamation and resettlement of the poor soils of southwest China, too, the use of fertilizers is likely often to make the difference between success and failure.

N. F. Chang
H. L. Richardson

ON THE NATURE OF VIRUS ADAPTATIONS

Filterable viruses are now generally recognized as highly specialized intracellular parasites. They not only are adapted to life within protoplasm, but also show specialized adaptations as to the kinds of cell that they invade and the species of animal in which they produce disease. The several adaptations appear to be distinctive for each individual virus and also to have a range of variation that is characteristic of each virus. Variations of the adaptations, within their ranges, are common in viruses occurring naturally; and by selection of the variations under experimental conditions, modified viruses of different kinds can be produced. Such terms as *neurotropic, dermatotropic* and *epitheliotropic* have been used to designate viruses that have special affinities for certain tissues. The term *pantropic* is used to describe a virus that invades a number of tissues without having a specialized affinity for any one of them.

There seem to be three fundamental adaptations of a virus as a parasite. The primary adaptation is to an existence within living protoplasm. It is this adaptation to growth within protoplasm that I have presented as basic to the transformation of visible microbes into ultramicrobes[1] by the process of retrograde evolution under conditions of parasitism. From the primary adaptation a virus obtains its fundamental characters in relation to a host-cell, such as growth only within the cytoplasm or the nucleus, the production of inclusion bodies before necrosis, the production of necrosis without inclusion bodies and stimulation of the host-cell to proliferation. This adaptation might be termed *cellular adaptation, protoplasmic adaptation* or *cytologic adaptation.* Inasmuch as the study of the cell is known as cytology, the most accurate term for adaptation of a virus to the cell would probably be the last named, *cytologic adaptation.*

Quite distinct is the adaptation of a virus to the type of host-cell[2] in which it grows. An expression of this specialization of a virus is seen in such terms as *neurotropic* and *dermatotropic.* The specialization does not seem to be an adaptation to a tissue or an organ, but specifically to a kind of cell which may, wholly or in part, make up a tissue or an organ. For example, the fox encephalitis virus produces a clinical encephalitis in foxes, but it is not a neurotropic virus, if this term indicates that the virus grows in nerve cells. It grows to the greatest extent in the cerebral vascular endothelium, to a less extent in the hepatic cells and not at all in nerve cells. In general, a virus appears to become adapted to grow best in one kind of specialized cell, but to a less extent it will grow in certain related specialized cells and also in more embryonic types of cell. This second adaptation might be called *organ-* or *tissue-specialisation,* but this does not seem satisfactory because a virus grows in types of cells regardless of their distribution in organs and tissues. It would seem that *histologic adaptation* best expresses the specialization of a virus with regard to the kind of cell in which it grows, since histology is the science of kinds of cells.

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[1] R. G. Green, Science, 82: 443–445, 1935.

[2] R. G. Green, "Proceedings of the International Assembly of the Inter-State Postgraduate Medical Association of North America" (October 13–17, 1941, Minneapolis, Minnesota), pp. 80–85. 1941.

The third type of virus adaptation is related to the species of animal which the virus invades or in which it produces a disease. This adaptation, like the others, appears to be distinctive for each virus. The rabies virus is broadly adapted in this respect, being capable of invading probably all species of mammals and birds. The distemper virus, which is more restricted, produces a disease only in members of the weasel family, the raccoons and the Canidae. The virus of the oral papillomatosis of dogs appears to be capable of invading only the dog. The adaptation to growth in a host-species or in a range of host-species might well be termed the *zoologic adaptation* of a virus.

While the cytologic adaptation of a virus seems to undergo little or no variation, the histologic and the zoologic adaptations seem to be subject to extensive natural variation. Within the ranges of the latter two adaptations, great experimental change can be effected in a virus by the selection of the species of animal injected and by the choice of tissue used as virus in serial host-to-host transfers. The distemper virus may be highly adapted to ferrets by host-to-host passage, becoming highly virulent for that animal and at the same time becoming a harmless, immunizing agent for members of the canine family. Distinctly different, artificially modified distemper viruses are produced by ferret-passage, depending upon whether the virus is passed serially through ferrets by subcutaneous injection and the use of spleen as inoculum; by intracranial injection and the use of brain tissue as transmission material; or whether it is passed by skin-to-skin inoculation. Such viruses are identical in their zoologic adaptation but differ in their histologic adaptation. A clear separation of these adaptations seems essential to qualify the nature of both natural and experimental viruses.

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URETHANE: ABSENCE OF PARALLELISM WITH THE ANTI-SULFONAMIDE ACTION OF p-AMINOBENZOIC ACID

THE demonstration by Johnson[1] that urethane (ethyl carbamate) exerts an anti-sulfanilamide effect on systems involving luminous bacteria led to the assumption that urethane should exert an anti-sulfonamide action by inhibiting the *in vivo* protective action of sulfonamides against streptococcal or other infections. That this assumption is not correct has been demonstrated in this laboratory.

p-Aminobenzoic acid (0.5 grams per kilo) completely inhibits the protective action of sulfanilamide (2.0 grams per kilogram) against a streptococcus infection (produced by the injection of 0.1 cc of a 24-hour broth culture of Strep. hemolyticus). Urethane (0.5 grams per kilogram) fails to inhibit the anti-streptococcal action of sulfanilamide (2.0 grams per kilogram). Approximately 500 mice were used to establish this point.

The failure to demonstrate an anti-sulfanilamide action by urethane in an *in vivo* system involving protection against streptococcus infections limits the applicability of data obtained from the study of luciferase systems to the broader aspects of sulfonamide action. The basic mechanisms involved in the luciferase system are not necessarily those involved in the anti-bacterial action of sulfonamides generally.

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BLUEBERRY STORAGE

DURING 1941 the Maine Agricultural Experiment Station conducted blueberry storage studies under controlled atmosphere and controlled temperature. These studies showed a great variation in the keeping quality of the different clones of low-bush blueberries and varieties of high-bush blueberries. The low-bush showed the greatest variation, as some of the clones with poor flavor when they were put in storage had good flavor when the storage period was completed. With other clones the reverse was observed. The fully mature and overripe berries did not keep well in storage and while they appeared good when removed from storage they became soft and wet before the berries could be retailed. In these experiments, the named varieties of high-bush blueberries did not store as well as some of the high-bush selections made in Maine.

The blueberries which were stored at 5° C and in an atmosphere with an oxygen content of 5 per cent. or slightly less were in the best condition at the end of the experiment. Carbon dioxide contents of from 13 to 15 per cent. in the atmosphere were not detrimental in these studies. These conditions are similar to those used by Van Doren *et al.*[1] in the storage of cherries, and the temperature was slightly higher than that recommended by Levine *et al.*[2] for the storage of cranberries. Commercially, blueberries may be kept for 2 to 4 weeks or from the middle of August to the first of September. For home use blueberries were stored for several months in sealed glass jars placed in the home refrigerator. The temperature in the home refrigerator was above the optimum for storage, but a very satisfactory result was obtained. The author enjoyed a delicious pie made from berries that had been kept in the home refrigerator for six months.

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[1] SCIENCE, 95: 104, 1942.

[1] A. Van Doren, M. B. Hoffman and R. M. Smock, *Proc. Amer. Soc. Hort. Sci.*, 38: 231–238, 1941.

[2] A. S. Levine, C. R. Fellers and C. I. Gunness, *Proc. Amer. Soc. Hort. Sci.*, 38: 239–242, 1941.

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SCIENTIFIC BOOKS

OVERFISHING

The Overfishing Problem. By E. S. RUSSELL, Director of Fishery Investigations, Ministry of Agriculture and Fisheries, Great Britain. 130 pp. Cambridge Press, 1942. New York: The Macmillan Company.

SELDOM does one find so clear and understandable, so forthright and unpretentious and so readable and entertaining a condensation of more than a half a century of scientific research as is found in Dr. Russell's little book embodying the De Lamar lectures delivered before the School of Hygiene of the Johns Hopkins University in March, 1939; nor could one conceive of a subject of greater importance to the fisheries of the United States with their potential six-billion-pound yield of war-time food than "the overfishing problem" which is the subject of these lectures.

Although the specific illustrations and the supporting scientific data were drawn chiefly from the fisheries of Great Britain, in the North Sea and from the Arctic Coast of Norway and Iceland, to the Atlantic shelf of Africa, the general principles which control anywhere in the world the development, the rise to maximum production and the ultimate decline of sea fisheries under intensive exploitation are clearly defined in such a way that the American reader will find frequent application to familiar conditions in home waters. Each of the lectures—(1) the exploitation of the fish stocks, (2) the depletion of the older grounds, (3) age analysis of fish populations, mortality rates and rate of growth, (4) the overfishing problem in its modern formulation, and (5) the regulation of the sea fisheries—is complete in itself and affords a leisurely hour's reading. Such a reading, however, will provoke many hours of thoughtful reflection, and such reflection should lead to profitable action on the part of American fishery interests.

In his conclusion, Dr. Russell says:

> We have seen in the course of these lectures that the state of overfishing exists in many of the trawl fisheries in Northwestern European waters. Two things are wrong. First, there is too much fishing, resulting in catches below the possible steady maximum, and second, the incidence of fishing falls too early in the fishes' life, resulting in a great destruction of undersized fish which ought to be left in the sea to grow. Mesh regulations, if sufficiently drastic, will cure the second evil so far as round fish are concerned, and they may well be reinforced by suitable size limits. For the first evil, there is only one radical cure, namely a reduction of the amount of fishing.

This is a familiar theme to fishery biologists in the United States who have reached identical conclusions from extensive data gathered over a period of years by the old Bureau of Fisheries and the present Fish and Wildlife Service. It is on the basis of such research that Herrington has recommended increased mesh sizes and minimum size limits for the New England trawl fisheries, and minimum size limits for lobsters; restrictions on the intensity of fishing have been recommended by Dahlgren for the Alaska herring and by Nesbit for the Atlantic shad and other shore species. The latter recommendation is based on a fundamental principle which Dr. Russell fully develops: ". . . that up to a point you can increase yield by increasing fishing, but after this maximum is reached the *more* you fish the less weight of fish you catch." From a series of simple theoretical calculations and from a great number of practical illustrations taken from many years' records of the British fisheries, he draws the general conclusion "that there must be for every fish an optimum rate of fishing. When the rate exceeds the optimum the yield will fall in spite of the increased effort expended."

Dr. Russell cites a well-known example of the benefits of a reduced fishing rate in the Northern Pacific halibut fishery in which legal control of the rate of fishing has been applied under the treaties made between the United States and Canada in 1924 and 1930, renewed in 1937. He recalls to us the fact that the formerly depleted halibut fishery was restored under regulation. On the southern banks the abundance of halibut increased by as much as 60 per cent. So great was the general increase in the stock that the fishermen are able to catch their limit in five months instead of in nine and the commission now estimates that the earnings of halibut fishermen are $1,000,000 a year greater than they would have been without regulation.

To an American fishery biologist the book is most refreshing not because the facts are new—they have all been published in the technical literature—nor because the conclusions and the plan of action for restoring the fisheries of Northwestern Europe are unique but because they parallel so closely the conditions revealed by fishery research in American waters and because the correctives for overfishing in Europe are the same as those that must be applied here. Indeed, Dr. Russell's conclusions have universal application and, although the method of applying them will vary for different species and in different localities, it is for this reason that the book merits thoughtful reading by American fishery administrators, operators and fishermen.

The American scientist also may well find the book a fascinating introduction to a distinct and rapidly developing field of science with which he is, by and large, quite unfamiliar. The late great Dr. Raymond Pearl recognized the affinities of fishery biology with the particular field of human biology in which he had labored so effectively. It is to him that the handful of us are so greatly indebted for the privilege of becoming acquainted with the rugged integrity and the kindly, homespun personality of Dr. Russell—a man honored at home with the Order of the British Empire for outstanding scientific work in a field so "lowly" as the fisheries.

ELMER HIGGINS

FISH AND WILDLIFE SERVICE,
WASHINGTON, D. C.

SOCIETIES AND MEETINGS

THE WISCONSIN ACADEMY OF SCIENCE

THE annual meeting of the Wisconsin Academy of Sciences, Arts and Letters was held at the University of Wisconsin, on Friday and Saturday, April 17 and 18. Forty-one papers were presented by members and guests of the academy, while 32 papers were read in sessions of three societies which met jointly this year with the academy—the Wisconsin Archeological Society, the Wisconsin Museums Conference and the Wisconsin Folklore Society.

Dean of speakers on the academy program was the 91-year-old ex-president of the University of Wisconsin, Edward Asahel Birge. Mr. Birge has been a member of the Wisconsin Academy since 1876, six years after the founding of the academy by act of the Wisconsin Legislature in 1870. During this period Mr. Birge has been one of the most regular of attendants at academy meetings, and has published many limnological articles in the *Transactions*. Mr. Birge delivered a paper entitled "The Relations between Water and Transmitted Sunlight."

Papers dealing with a wide variety of subjects were presented by academy members from Wisconsin colleges and universities, as well as by members from outside of Wisconsin. Two programs of correlated papers were arranged by Professors Lowell E. Noland and Arthur D. Hasler, both of the zoology department of the University of Wisconsin. The first-named group included several papers on the fresh-water clam, *sphaerium*, and the snail *Lymnaea stagnalis*. Professor Hasler's group of papers included a series of studies of Lake Geneva, Wisconsin, where in the summer he is the director of the Lake Geneva Institute of Natural Science.

Officers elected for 1942–1943 are as follows: A. W. Schorger, Madison, *President;* W. N. Steil, Milwaukee, *Vice-president in Sciences;* Ralph Buckstaff, Oshkosh, *Vice-president in Arts;* Berenice Cooper, Superior, *Vice-president in Letters;* Loyal Durand, Jr., Madison, *Secretary-Treasurer*. The secretary is also editor of the *Transactions*, a new number of which is being started to press. Award of the research grant from the American Association for the Advancement of Science was made to Professor James F. Groves, of Ripon College.

LOYAL DURAND, JR.,
Secretary

NORTH CAROLINA ACADEMY OF SCIENCE

THE forty-first annual meeting of the North Carolina Academy of Science was held at the Woman's College of the University of North Carolina, Greensboro, on April 24 and 25. Despite emergency curtailment of tires and gas and despite the fact that many of our members are directly engaged in war work, the meeting was well attended. About 300 scientists heard a varied program of some 70 papers. The North Carolina Section of the American Chemical Society met at the same time and place with 9 papers on their program.

A new section dealing with the problems of wildlife conservation and management was organized this year. The program of 10 papers was heard by a large group, and considerable discussion followed each paper. This appears to be a very desirable section, which promises to grow in interest, and one which may operate to the profit of all who are interested in making the most of our wildlife.

In addition to the usual sectional program of formal papers the psychologists held a panel discussion on

"The Psychological Aspects of Morale." The meeting was well attended and evoked considerable interest and discussion.

The Poteat Award was conferred on J. P. Decker, of Duke University, for his paper on "The Effect of Temperature on Photosynthesis in Red and Loblolly Pines." The High School award of $20 went to Ernest Hardwick and Arthur Budlong, of the Winston-Salem High School. They demonstrated a home-made stroboscope.

After a complimentary dinner given by the Woman's College, Dean Jackson in his address of welcome lauded two former academy members, also former teachers at Greensboro, for their achievement in the scientific world. They were Gilbert T. Pierson and E. W. Gudger. Dr. R. E. Coker then delivered the presidential address, taking as his subject, "What Are the Fittest?" The address was a zoologist's view of the present world conditions. After the address an informal open house gave opportunity for renewing old friendships and establishing new ones. During this time the group experienced its first blackout.

Committee reports were made in mimeographed form, and these along with the treasurer's preliminary report were adopted. The secretary reported the election of about 50 new members. This makes a total of more than 225 new members elected in the last three-year period.

The following officers were elected: *President,* H. F. Prytherch, of the Bureau of Fisheries; *Vice-president,* Eva G. Campbell, of Guilford College; *Secretary-Treasurer,* Bert Cunningham (re-elected for a three-year term), of Duke University; *New Member of the Executive Committee,* O. J. Thies, of Davidson College; *New Member of the Research Grants Committee,* J. P. Givler, of the Woman's College.

A more detailed report of the meeting will appear in the *Journal* of the Elisha Mitchell Scientific Society.

BERT CUNNINGHAM,
Secretary

SPECIAL ARTICLES

THE RELATION OF URINARY CITRIC ACID EXCRETION TO THE MENSTRUAL CYCLE AND THE STEROIDAL REPRODUCTIVE HORMONES

THE role of citric acid in mammalian metabolism still remains obscure. Some of the prevailing theories and factual observations relating to this metabolite may be reviewed briefly. It is present in small amounts in the tissues and body fluids, and is a constant urinary constituent, (0.2–1.2 gms/24 hrs. in man.) It is evidently a product of endogenous metabolism, since it continues to appear in the urine during starvation, and the amounts excreted under normal conditions are greatly in excess of those present in the food or stored in the tissues.[1] Krebs, as a result of studies on minced tissues,[2] has assigned to it an important role in carbohydrate oxidation, but his theory still awaits support from work on intact tissue. In the living organism, citric acid has been shown to enter the carbohydrate cycle, but in a manner not implicit in the citric acid cycle postulated by Krebs. It exerts an anti-ketogenic effect and overcomes insulin hypoglycemia.[3] It is converted almost quantitatively to glucose in the phlorhizinized dog, and deposited as liver glycogen when fed to normal rats.[4, 5] It has also been found to be related to acid-base regulation. Alkalosis, however induced, leads to an increase in urinary citric acid, excretion generally varying directly with urinary pH.[6] Finally, the unusually high citrate content of bone[7] is suggestive of some connection with calcium metabolism. The present paper links citric acid to still another physiological process, the menstrual cycle.

We wish to report experiments with human subjects which have revealed a relation between citric acid excretion and the steroidal reproductive hormones. These experiments were carried out on five young women with regular menstrual cycles, two young women with amenorrhea, and one hypogonadal male. Except in the case of two female subjects, both laboratory workers, the studies were carried out in the Metabolism Ward of the Department of Medicine in order to insure accurate urinary collections and proper dietary control. Citric acid was determined by a modification of the pentabromacetone method.

Analysis of the daily urinary excretion of citric acid during six complete menstrual cycles of the five subjects studied, showed, in all cases, a characteristic cyclic alteration in the level of the citric-acid content during the different phases of the menstrual cycle. The lowest levels always occurred during menstruation, the highest, at about the middle of the cycle. The shape of the curve varied with the different subjects, both with respect to the rapidity and height of the midmenstrual rise, and the duration of the increased excretion. In one patient studied over two consecutive cycles, the shapes of the excretion curves were similar in both cycles. In four cycles, a brief, but significant, fall in excretion occurred midmenstrually and lasted for one or two days. In four cycles, the higher level of citric acid excretion persisted during most of the second half of the cycle, to fall abruptly two or three days before the next flow. The maximal midmenstrual increases in citric acid excretion over the menstrual levels were 225, 240, 275, 350, 450 and 500 mgs for the six cycles studied.

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[1] C. C. Sherman, L. B. Mendel and A. H. Smith, *J. B. C.*, 113: 247, 1936.

[2] H. A. Krebs and W. A. Johnson, *Enzymologia*, 4: 148, 1937.

[3] E. M. MacKay, H. O. Carne and A. N. Wick, *J. B. C.*, 133: 59, 1940.

[4] I. Greenwald, *J. B. C.*, 18: 115, 1914.

[5] C. A. Kuether and A. H. Smith, *J. B. C.*, 137: 647, 1941.

[6] O. Östberg, *Skand. Arch. Physiol.*, 62: 81, 1931.

[7] F. Dickens, *Biochem. Jour.*, 35: 1011, 1941.

The accompanying graph (Fig. 1) illustrates the characteristics of the curve of citric acid excretion during the menstrual cycle of one of the subjects. The post-menstrual rise, the sharp midmenstrual dip, the persistence of the high level of excretion during most of the premenstrum, and the abrupt fall to the previous menstrual levels, were particularly striking in this subject.

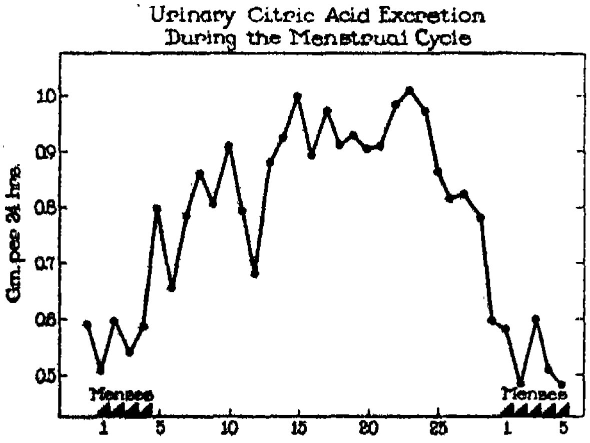

FIG. 1.

Results, of a preliminary character, can be reported of experiments designed to analyze the relation of the individual steroidal reproductive hormones to the cyclic alterations in citric acid excretion during the menstrual cycle. An estrogenic hormone, (estradiol benzoate), was administered to two amenorrheic girls in amounts that did not exceed their estrous requirements, as judged by vaginal smears. Both subjects showed significant increases in citric acid excretion (230 and 500 mgs, respectively), during its administration, and a sharp return to lower levels on cessation of treatment. We are now investigating the possible influence of progesterone on citric acid excretion, in view of the fact that the high level of excretion is generally maintained throughout most of the second half of the cycle. The reverse effect on citric acid excretion was observed when an androgen, testosterone, was administered to a male with pituitary hypogonadism. During two courses of treatment, urinary citric acid fell significantly, (300 mgs/24 hrs.), below the control values and rose sharply to previous levels when treatment was terminated. In one amenorrheic girl, testosterone propionate likewise reduced the daily output of citric acid by 175 mgs. Additional studies on human subjects and animals are under way to ascertain the constancy and prevalence of these phenomena.

The studies on the female subjects were correlated with vaginal smears. The results of the correlation of this index of ovarian function with the excretion of citric acid will be reserved for a subsequent report.

These observations would appear to establish the existence of a cycle of citric acid excretion which bears a definite relation to the menstrual cycle and is probably hormonally conditioned. This cycle may result from a direct effect of the hormones involved on citric acid metabolism, or from their influence on some other mechanism, such as acid-base regulation, renal function or carbohydrate metabolism, which in turn influences citric acid formation and excretion. Since citric acid is but one of the organic acids eliminated in the urine, it will be necessary to determine whether or not excretion of other organic acids is also altered under these conditions, before the changes in citric acid excretion can be regarded as specific. The bearing of these results on all previous experiments dealing with citric acid excretion in women is obvious.

Although these experiments throw no new light on the basic problem of the endogenous metabolism of citric acid, they do point out a new functional relationship, and should provide a valuable tool to aid in its study.

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PHYSIOLOGIC STUDIES ON THE CORNEA

THE cornea is a composite membrane forming the anterior portion of the outer coat of the eye-ball. In all vertebrates it has on its anterior surface a thin, stratified epithelial layer and on its posterior surface a single layer of endothelial cells. Just anterior to the endothelium is a homogeneous elastic lamina (Descemet's membrane), and just beneath the epithelium there is, in some species, a homogeneous glass-like lamina (Bowman's membrane). The remainder of the cornea, the substantia propria, comprising about 90 per cent. of its total thickness, is made up of collagenous fibers and supporting cells arranged parallel to the surfaces of the cornea. These fibers merge into those of the sclera without any abrupt histologic transition corresponding to the change from the transparent to the opaque portion of the corneoscleral coat.

The permeability, the degree of hydration, the transparency and the absence of blood vessels are four properties which distinguish the cornea from the sclera, and indeed from most other tissues. These properties have been extensively studied in this laboratory during the past two years and, as a result of the new findings, especially as regards permeability, have led to a new concept of corneal physiology. The data are to be reported in detail elsewhere.[1] A preliminary report of some of the findings and conclusions which are of general interest are presented here.

The excised cornea was found to be, in effect, *impermeable in either direction to NaCl but freely permeable in both directions to H_2O.* Removal of the epithelium caused the cornea to become permeable to NaCl, from which it was concluded that the epithelium was an effective semipermeable membrane with respect to NaCl. The permeability of the endothelium could not be adequately studied with the excised cornea because of damage resulting from the manipulation. But if the corneal epithelium is first removed the properties of the endothelium may be studied in the intact eye. In this manner it was shown that the endothelium is substantially like the epithelium in being an effective semipermeable membrane with respect to NaCl. Thus the substantia propria, while permeable to NaCl and water, is bounded on either side by membranes permeable only to water.

The normal degree of corneal hydration appears to be *quite unusual, for when pieces of cornea are immersed in various aqueous solutions they swell several hundred per cent.* This was found to be true, even though the bath fluid was blood serum or aqueous humor and despite wide variations in hydrogen ion concentration or in tonicity of the solutions. The only way in which the explanted cornea could be maintained in a state of dehydration comparable to that existing normally was by maintaining an osmotic gradient across the intact epithelium or endothelium, or both, so that water was abstracted from the cornea as rapidly as it became available in the stroma. Presumably a similar mechanism is operative *in vivo;* fluid diffuses into the cornea from the vascular plexus at the corneo-scleral junction, and its water is continuously transferred into the hypertonic tears on the anterior surface and into the hypertonic aqueous on the posterior surface.

The maintenance of corneal dehydration is essential for transparency. Removal of the semipermeable membranes or lowering the tonicity of the bath fluids will allow the cornea to swell and become opaque. Presumably the interstitial fluid, having a different refractive index from that of the structural components of the cornea, must be removed or prevented from accumulating in order to maintain optical homogeneity.

Correlated with the dehydrating mechanism as described above is the effect on circulation. The cornea has no vascular or lymphatic vessels, and nutritive material is provided by diffusion from the periphery. It now seems likely that, in addition to diffusion, the continuous abstraction of water from the corneal surfaces ensures a movement of fluid which serves to transport oxygen and other dissolved materials from the blood to the corneal tissues.

By contrast the sclera has no semipermeable membranes and therefore no dehydrating mechanism as described above for the cornea. In consequence, the sclera is normally hydrated to its physiologic limit and is opaque. If, however, it is artificially dehydrated, as by drying in air, it becomes transparent like the cornea. The optical difference, then, between the cornea and sclera appears to be due, not to any structural difference in their respective fibers, but to the fact that the former has a dehydrating mechanism not present in the latter.

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PHYSIOLOGICAL ACTIVITY OF ASCORBIC ACID IN PLANT LIFE

THE diurnal variation of ascorbic acid in tomato plants previously noted,[1] if common to all plants, merits further consideration in determining the best time to harvest edible greens. If greens are to be shipped or canned, is it preferable to cut them in the evening or in the morning? Using young tomato plants grown in pots as subject material, a number of pertinent experiments have been made.

The plants to be allowed to grow overnight were washed free of soil gently to avoid root injury; adhering water was blotted off with absorbent paper; the plants were weighed and at once replanted. Such repotted plants gained very little in weight overnight even though the pots were standing in water to cover the soil, whereas cut plants standing in water always gained appreciably.

Knowing the change in weights of the plants held overnight, both cut and growing, it was possible to calculate the ascorbic acid content in the morning back to the weight of the previous evening and thus eliminate the dilution effect. Typical results are given in Table 1, the morning ascorbic acid values calculated back to the weight of the plants in the evening. The figures in parentheses represent the per cent. increase in weight of the plants overnight.

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[1] *Archives of Ophthalmology.*

[1] SCIENCE, December 13, 1940, p. 561.

TABLE 1

ASCORBIC ACID VALUES—MG PER CENT

	Expt. 1	Expt. 2	Expt. 3
Evening (4–5 P.M.)	62.8	52.0	46.3
Next morning—cut plants (8–9 A.M.)	47.7 (15)	32.9 (18)	22.5 (12)
Next morning—uncut plants (8–9 A.M.)	31.5 (0)	27.8 (3.5)	18.2 (2)

From these data it appears that the cut plants retained, respectively, 51, 18 and 24 per cent. more ascorbic acid than the growing plants in the three experiments; even though the cut plants gained 10 to 15 per cent. more in weight, their percentage of ascorbic acid was, respectively, 34, 7 and 10 per cent. higher than uncut plants in the three experiments.

The data indicate that the losses in ascorbic acid noted in vegetables and fruits in storage are not due entirely to oxidation by atmospheric oxygen, as is often stated, but due to its being used in some physiological process, the activity of which is diminished by severing the plant from the root system.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN EGG INOCULATOR AND SHELL MEMBRANE TEASER FOR VIRUS CULTURE

IN view of the extensive use now made of the chorio-allantoic membrane of chick embryos for the cultivation of viruses, it seemed desirable to simplify the technique of inoculation and at the same time, if possible, decrease the losses due to accidental injury of the membrane. The egg inoculator, shown in Fig. 1, satisfies these requirements.

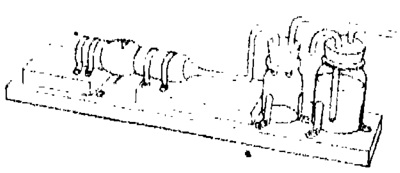

FIG. 1. Egg inoculator.

A triangular window is cut in the shell in the usual manner and a hole drilled into the air sac. The egg is then placed between the two rubber rings of the inoculator. The one which grasps the pointed end of the egg is mounted on a movable base actuated by springs which force the rings together. The other ring forms a tight junction with the egg and is connected with a suction device. A simple by-pass prevents the suction from becoming great enough to cause damage. When the suction exceeds the hydrostatic pressure of 5 centimeters of water, air passes down the tube and bubbles up into the system, maintaining the negative pressure at a constant level. The air sac and through it the interior of the egg is, in this way, subjected to a continuous negative pressure while the fragment of shell is being removed and the slit made in the shell membrane.

Instead of a needle for making the slit in the membrane, a shell membrane teaser is used. This is easily formed from a single limb of a pair of curved forceps. The tip is bent backwards in such a way that when the instrument is applied vertically to the shell membrane, and then drawn sideways, the serrations catch the fibers of the membrane. The lateral traction causes a tear in the membrane at a slight distance from the teaser. The location of the slit, together with the fact that the constant suction causes the chorio-allantois to drop the instant the slightest tear forms in the shell membrane, combine to prevent injury by the instrument to the chorio-allantois. The egg is now ready for inoculation in the usual manner.

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A QUANTITATIVE VAPORIZER

AIR disinfection depends upon quantitative dosage control. Vaporization of chemical disinfectant may be quantitatively controlled by regulation of heat applied. In non-conducting fluids resistance coils can be submerged directly into the liquid and, since heat loss from the walls of a vessel at constant temperature (near boiling point of the fluid) is uniform, the excess heat absorbed in vaporization can be regulated by the amount of current supplied to the coil.

The sketch shows a simple U tube with a short length of heating element immersed in propylene glycol used in experimental study of chemical disinfection of air. To prevent uncovered resistance wire from reaching ignition point, copper leads transmit the current through the liquid to the coil. The air stream passing over the surface of the liquid carries the vapor into the dosing chambers.

An ordinary heating element submerged in a beaker of propylene glycol will evaporate upwards of a gram per minute. Care should be taken not to allow resistance wire carrying current to emerge from liquid surface, and to insure against this possibility it may be desirable to provide a constant level device. Other adaptations may provide convenient means of vaporizing propylene glycol or other non-conducting fluids in experimental air disinfection.

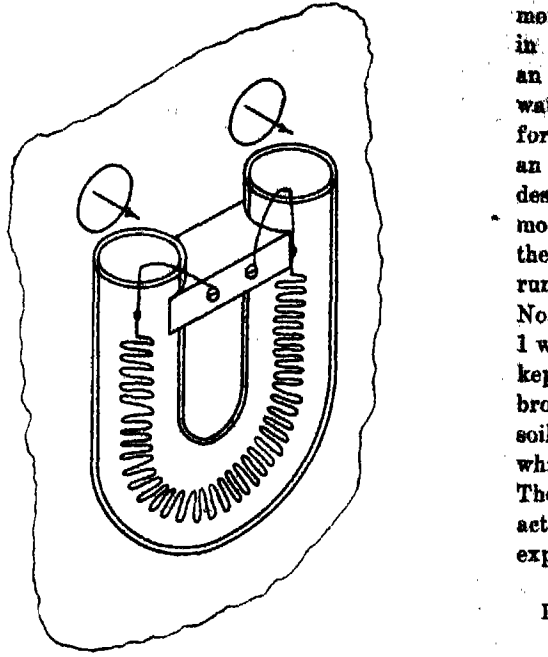

FIG. 1.

W. F. WELLS

LABORATORIES FOR THE STUDY OF
AIR-BORNE INFECTION,[1]
UNIVERSITY OF PENNSYLVANIA
SCHOOL OF MEDICINE

HEAT INACTIVATION OF WHEAT MOSAIC VIRUS IN SOILS

WHEAT mosaic virus *Marmor tritici* H.[1] is of interest not only because of the economic losses induced in winter wheat in certain wheat-growing areas of the Midwest, but also because it may be directly transmitted from the soil. Previous studies[2, 3, 4] on the relationship between soil and virus suggested an investigation to determine the resistance of the virus in the soil to heat. Virus-infested soil at optimum moisture content was passed through a screen of ¼-inch mesh, placed in stoppered test-tubes 3 cm by 20½ cm in size and tamped lightly. Twenty-five soil samples contained in these tubes were heated at each of the temperatures: 40°, 50°, 60°, 70° and 80° C. A thermometer was inserted into the center of one tube in each series of tests and the samples immersed in an electrically heated and thermostatically controlled water bath. The tubes were spaced and the water forced to circulate freely between them by means of an electric stirrer. After the soil had reached the desired temperature in the tube containing the thermometer, a 10-minute exposure was given, after which the tubes were removed and immediately cooled in running tap water. The soil was then emptied into No. 10 tin cans. Wheat seeds of variety Purdue No. 1 were planted in the treated soil and the young plants kept outdoors over winter. After dormancy was broken it was found that all wheat plants grown in soil heated at 40° and 50° C were affected with mosaic, while all plants in the remaining series were healthy. These results indicate that wheat mosaic virus is inactivated in the soil between 50° and 60° C at an exposure of 10 minutes.

FOLKE JOHNSON

DEPARTMENT OF BOTANY,
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BOOKS RECEIVED

Annual Review of Physiology. Edited by JAMES MURRAY LUCK. Pp. 709. American Physiological Society and Annual Reviews, Inc. $5.00.

BENEDETTI-PICHLER, ANTON ALEXANDER. *Introduction to the Microtechnique of Inorganic Analysis.* Pp. vii + 302. Wiley. $3.50.

BOWLBY, JOHN. *Personality and Mental Illness.* Pp. viii + 280. Emerson Books. $2.75.

Bulletin of the Health Organization. Vol. IX, No. 4. Pp. 371–491. League of Nations, Geneva. $1.00.

CLARK, PAUL F. and ALICE SCHIEDT. *Memorable Days in Medicine.* Pp. 305. University of Wisconsin Press. $2.00.

DEMING, HORACE G. *Introductory College Chemistry.* Second edition, revised. Pp. xii + 521. Wiley. $3.00.

GANN, ERNEST K. *Getting Them into the Blue.* Pp. 154. Illustrated. Crowell. $2.00.

HOGG, JOHN C. and CHARLES L. BICKEL. *Laboratory Manual to Elementary General Chemistry.* Pp. x + 223. Van Nostrand. $1.60.

JOHNSON, FREDERICK. *The Boylston Street Fishweir.* Pp. xii + 212. 16 figures. 14 plates. Phillips Academy Foundation.

PEPPER, STEPHEN C. *World Hypotheses.* Pp. xiii + 348. University of California Press. $2.50.

Proceedings of the Eighth American Scientific Congress. Volume I. Edited by PAUL H. OEHSER. Pp. 689. Department of State, Washington, D. C.

SAMPSON, KATHLEEN and J. H. WESTERN. *Diseases of British Grasses and Herbage Legumes.* Pp. 86. 15 figures. 8 plates. Macmillan. $1.50.

SARGENT, PORTER. *Education in Wartime.* Pp. 224. Sargent. $1.50.

SHELDON, WILLIAM H. *The Varieties of Temperament.* Pp. x + 520. Harper. $4.50.

TENNENT, DAVID HILT. *The Photodynamic Action of Dyes on the Eggs of the Sea Urchin, Lytechinus Variegatus.* Pp. 153. 40 figures. 6 plates. Carnegie Institution of Washington. Paper, $1.25. Cloth, $1.75.

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[1] These laboratories are supported by a grant from the Commonwealth Fund to the University of Pennsylvania for studies in the prevention and control of air-borne infection.

[1] F. O. Holmes, "Handbook of Phytopathogenic Viruses." Minneapolis, Minn.: Burgess Publishing Company.

[2] H. H. McKinney, U. S. Dept. of Agr. Bull. 1361, 1925.

[3] R. W. Webb, *Jour. Agr. Res.*, 35: 587–614, 1927.

[4] R. W. Webb, *Jour. Agr. Res.*, 36: 53–75, 1928.

SCIENCE

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THEATERS, GARDENS AND HORTICULTURE[1]

By Dr. C. STUART GAGER

BROOKLYN BOTANIC GARDEN

I APPRECIATE the gracious words of President Nason, and I accept the award of the Arthur Hoyt Scott Foundation with a sense of profound gratitude to the committee of award, and especially to those who established the foundation, which has been, and which will continue to be, a potent factor in the encouragement and enrichment of American horticulture, in memory of one whose interest in plants reflected the highest ideals and accomplishments of a gifted amateur.

To be deemed worthy of a place in a group of medalists which includes Mr. John C. Wister, Professor Liberty Hyde Bailey and Mr. J. Horace McFarland, the previous recipients of this award, and Mr. Richardson Wright, to-day's recipient, is an honor which any one might justifiably covet.

And I specially appreciate the privilege and honor of having some part in the dedication of this beautiful outdoor theater, which adds so much to the cultural charm of Swarthmore College, already rich in cultural assets and traditions.

It is superfluous to say that every friend of Swarthmore is under special obligation to Mr. Thomas B. McCabe, of the class of 1915, whose generous interest in the college and in the promotion of all that is best in life has made this theater possible, as a memorial to Arthur Hoyt Scott.

The wish to be of service to mankind through the medium of botanical science, to help "the man in the street," as well as the scientist, appreciate something of the beauty of the plant world, and of the significance and importance of a knowledge of plants, has been the inspiration of all that has been accomplished during thirty-two years at the Brooklyn Botanic Garden; and now to have this recognition as a token of public appreciation and approval, has aroused in the recipient "an emotion warmer than mere intellectual gratitude."

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[1] Given at Swarthmore College on May 23, on the occasion of the presentation of the 1941 Arthur Hoyt Scott Garden and Horticultural Award of a gold medal and $1,000, and the dedication of a new open-air theater on the campus.

If anything has been accomplished at the Brooklyn Botanic Garden during the past thirty-two years worthy of such recognition as this, it is due to the support and encouragement of generous and philanthropic trustees and other citizens and to the loyal cooperation of an able staff, which has made possible the development of an institution after a pattern which, in its entirety, is essentially new for a botanic garden.

Nothing, of course, can surpass the solid satisfaction of being able to spend one's life in doing what one most likes to do. In 1675 the Italian, Malpighi, cofounder with Englishman, Nehemiah Grew, of the science of plant anatomy, wrote, "In performing these researches so many marvels of nature were spread before my eyes that I experienced an internal pleasure that my pen could not describe." Happy is the man who, as I can do, may write thus of his life-work. But there is a deep gratification also in being made to realize that the results of one's efforts have commended themselves to others who are competent to judge, and that they have been of benefit to mankind.

An outstanding award, such as this one, not only gives confidence and encouragement for the future, but it can not fail to direct favorable public attention to the undertaking thus recognized, and thereby encourage the moral and financial support without which no institution can prosper.

In the year 1593 Queen Elizabeth made an official visit to Oxford University. The Latin play performed in her honor was written by my ancestor, an Oxford don, the Christ Church dramatist, Dr. William Gager. The Puritans of that time were violently opposed to the theater, and Gager's Latin plays brought down upon him the wrath of this unfriendly sect, led by Dr. John Rainolds, of Queen's College, Oxford. To prove the ungodliness of Dr. Gager, Rainolds published a book, "Th' overthrow of Stage-Playes," which is famous in the history of the academic stage.

And so it has been of interest to me, and may possibly have a mild interest for this audience, that almost exactly 350 years after the noise of battle between the Puritans and my ancestor died away, a Quaker college, presided over by a president who is an Oxford graduate, now invites a descendant of William Gager to give an address in dedication of an outdoor theater on the campus. So the wheels of history go 'round!

In that unusual "Swarthmore Saga," "An Adventure in Education," by the Swarthmore College faculty, relating the advances made by the college during the nineteen years of the administration of President Aydelotte, it was possible to refer truthfully to the Swarthmore campus as "a campus which is one of the horticultural delights of eastern Pennsylvania." And one may now add the statement, with confidence, that no campus combines, at the same time, more educational value in horticulture with horticultural beauty. Nature has done much for the Swarthmore campus, and this has been taken advantage of to the fullest extent by the authorities—and notably in this newest feature of an outdoor theater, converting natural topography and scenery into a place of delightful outdoor assembly.

A brief word about the history of outdoor theaters and the term scenery may not be without interest at this time and place. As is well known, the word "theater" is from the Greek verb theáomai (*ϑεάομαι*), meaning "to view," "to behold," and giving us finally the word *théatron* (*ϑεατρον*), meaning "a place for seeing," "a theater." The theater, like most elements of our secular culture, originated in Greece. At first it was nothing more than a dancing circle or orchestra, (*ὀρχήστρα*) marked out around an altar, and, like this one, it was commonly located at the foot of a hillside on which the audience stood or sat. Later there were tiers of wooden seats built against the hillside for the audience. The most prominent and important object was an altar of Dionysus, placed in the center of the *orchéstra*. There was no stage, and the theater was regarded as the temple of Dionysus, who was the very heart of all Mediterranean religion.

In the classic theater on the southeast side of the Acropolis, in Athens, the temple of Dionysus Eleuthereus stood back and to one side of the circle, and to meet a need of the actors a tent was placed at the edge of the *orchéstra*, where the actors might retire for changes of costume. The Greek word for tent is *skene* (*σκηνή*), from which we have our words "scene" and "scenery."

It is common knowledge that, in their theaters, as in many other ways, the Romans copied the Greeks. The outdoor theater of Pompey, in Rome, built about 52 B.C., seated about 10,000 persons. At its inauguration some 500 lions and 20 elephants were killed by gladiators. To-day, it would appear, the outdoor theater is inaugurated or dedicated by a program which includes the slow torturing of the entire audience by an actor selected, as here and now, for that specific purpose.

But what has the theater got to do with horticulture? Dionysus, the divine patron of the drama, was also a "Year-God" or "Vegetation-Daemon," and the death and re-birth of Dionysus are the very essence of Greek tragedy. The reawakening of vegetation every spring was regarded by the Greeks as heralding his resurrection. Dionysus was also the god of wine, the product of the vine, and the great philosopher, Spinoza, tells us that, "It is the part of a wise man to feed himself with moderate, pleasant food and drink, and to take pleasure . . . with the beauty of growing plants . . . and theaters."

How interesting to recognize that horticulture has been so intimately related to the most profound concerns of the human mind—to art, to science, to education, to the drama, to religion. And how fitting to have upon this campus, so interesting and so beautiful horticulturally, the added feature of an open-air theater.

When Aristotle, about 375 years before Christ, established at Athens the first "botanic garden" of record, and placed his pupil, Theophrastus, in charge of it, the main object, as in the Arthur Hoyt Scott arboretum, was to provide a place for growing native and foreign plants, thus making them more easily accessible for study. We are told that the botanical researches of Theophrastus were based primarily on this collection of plants.

But Theophrastus, like Aristotle, was essentially a teacher, and he embodied the results of his lectures on plants in nine books and published them. Thus, from this early and primitive botanic garden, there emerged the two fundamental aims of all subsequent botanic gardens, namely, the advancement and the diffusion of a knowledge and love of plants; thus, also, were set the standards and the limitations of the activities of botanic gardens for nearly two thousand years—the search for new knowledge and the publication of the results *for the educated minority* of mankind. And this statement is made not to criticize but to commend, for in this way the greatest need of botanical science was met.

It would be difficult to exaggerate man's ignorance of plant life from the time of Aristotle even up to the nineteenth century. We say that the function of a botanic garden is the advancement and diffusion of knowledge; but in Aristotle's time, and for many centuries thereafter, there was not only no receptive general public for popular scientific education, but there was very little botanical knowledge to diffuse. This was due in part to lack of research and in part to the stupefying influence of superstition.

Nowadays every schoolboy and every schoolgirl knows the parts of the flower and the functions they perform. In Aristotle's time practically nothing was known of this, and it was not until 1793—almost the beginning of the nineteenth century—that Christian Konrad Sprengel, by painstaking research, demonstrated beyond dispute the rôle of insects in transferring pollen from one plant or flower to another.

As for the effect of superstition on scientific inquiry, we may cite the statement of Jerome Bock. He was a teacher, preacher, physician and botanist. His "*New Kreuterbuch,*" first published in 1539, had six subsequent editions, and inaugurated the subject of plant description for the first time since Theophrastus. He was the first man to describe the stamen of flowers as made up of two parts, and the first to use the words "pistil" and "pollen." I refer to these matters as indicating his intellectual power and originality. He was one of the educational leaders of his time. But when he describes his investigations by which he was the first to discover that ferns reproduce by spores, he tells us that he made his observations on four successive years, in each case watching "all the night before the feast of St. John the Baptist." His own superstition and that of his contemporaries is further indicated by his statement that, "In these experiments I made use of no magic, or conjuring, or incantations"!

Illustrations of the newness of what is now common knowledge might easily be multiplied, but those just cited are specially appropriate to recall on this occasion, for they are foundational to the whole subject of plant breeding and ornamental horticulture. Without this knowledge of plant reproduction—of the structure and function of flowers—we should have only the "wild" flowers that "nature" provides, and we should lack all the innumerable horticultural varieties of iris and lilacs, peonies and roses, flowering cherries and chrysanthemums—not to mention the "bigger and better," earlier and prolificer varieties of fruits and vegetables with which our modern gardens are enriched. Without this knowledge it would be much more difficult to feed the enormous army we are now being forced to mobilize.

But civilization never stands still, and one of its greatest forward strides was the gradual but steady diffusion of democracy and, with democracy, of education among the masses. That which was known only to the intellectual aristocracy in the Middle Ages is now taught in all our public schools. It is not only free to all, it is compulsory to learn it.

The idea that the general diffusion of the method and results of science was second only in importance to scientific research has spread steadily, but all too slowly, since about 1875, when Asa Gray did not think it beneath his dignity as the greatest American botanist to write for public consumption his illuminating and non-technical little books on "How Plants Grow" and "How Plants Behave." This, and other similar instances, are striking illustrations of the truth that the humanizing and popularizing of knowledge are quite as important as the increase of knowledge.

In 1921, at the inaugural dinner for Dr. Aydelotte, the then new president of Swarthmore, Mr. George Walton, of the George School, wisely stated that "The Golden Age of Quakerism lies ahead. Its greatest activity will be education." It was such a recognition as this of the importance of education and of testing new ideas of education, that led to the formulation of the program of activities of the Brooklyn Botanic Garden when it was established in 1910. A new opportunity and therefore a new obligation for botanic gardens was recognized—not only that our knowledge of plant life should be promoted by scientific research, but that popular education concerning plant life should render to the general public a definite return in the way of public service along the lines of intelligent popular interest and public need. And so the keynote for the Garden was adopted and announced—"For the advancement of botany and the service of the City."

It seems fitting at this time to give a brief statement of the nature of the work as well as of the underlying philosophy for which the Arthur Hoyt Scott Award for 1941 has been made, for it is of general application.

For many years the Brooklyn Botanic Garden, so far as known to the speaker, has administered the most extensive and most varied program of popular public education of any botanic garden in the world, including not only what is now known as "adult education," but also courses of informal instruction for children in greenhouses and plantations. The scope and nature of the Garden's work has been stated as, "Anything scientific or educational based upon plant life," beginning with children's gardens (conducted primarily as an educational discipline) and including all aspects of botany and horticulture.

Many boys and girls have voluntarily attended these courses for children for from three to eight years consecutively, and many have thereby discovered their major interest in life, have taken their Ph.D. in botany and have become college professors of botany or horticulture or have gone into commercial horticulture for a life work.

The annual attendance at courses and lectures has averaged more than 100,000 a year. During the past twenty-nine years of the Garden's existence it has exceeded a grand total of more than 2,600,000 adults and children.

The plantations of the Garden have been developed as an outdoor museum of plant life. The diversity of the plantations, which comprise some twenty different kinds of gardens, led one of our friends to refer to them as "Gardens within a garden," and this designation has been officially adopted.

Of course the great tradition inaugurated by Aristotle's Garden—the advancement of botanical knowledge by research—has not been neglected. The investigations undertaken have resulted in substantial additions to knowledge which have been applied in connection with the maintenance of our own plantations, utilized in connection with a bureau of free public information, and given to the public through publications.

And I must mention one more aim and accomplishment as being most closely related to the interests of the founder and the namesake of the Arthur Hoyt Scott Foundation, and that is the beauty of the plantations. I quote from the Annual Report of the Garden for 1939:

> While the primary aim of the botanic garden is educational, we should minister not only to those who come to learn the Latin name of the Lilac, or what plant family comes between the Buttercups and Roses, or the latest variety of Iris, but also to those who come to seek only happiness and re-creation amidst beauty. And thus it becomes a fundamental aim to make the Brooklyn Botanic Garden as beautiful as possible.

The speaker's experience of thirty-two years has driven home the lesson that to develop an efficient botanic garden or arboretum takes time and patience and cooperation. Always and continuously it requires the education of the public and the trustees as to the aims and opportunities and requirements. That the highest efficiency requires adequate financing is a truism. That fact, however, is not always recognized and, when it is, it is not always easy to realize.

Just as plants grow old or obsolescent and have to be replaced from time to time with new or better plants, so also does knowledge about plants and their culture continually need revising and replacing with new ideas and information resulting from research.

In his "Ten-Year History" of the Scott Foundation, the present director, Mr. Wister, has stated this aspect of the work most effectively, pointing out the need of further studies in the breeding of ornamental plants, in their diseases, in their relation to their environment, in their nutrition, in their relationship to each other and in their naming.

The problems outlined, says your director, "are continuing ones, which could probably demand the attention of the Scott Foundation decade after decade." And I may add, it is attention to such necessary problems that raises a true arboretum or botanic garden above the level of a commercial nursery and makes it in a very real sense an educational institution.

The "Ten-Year History" quotes the great first director of the Arnold Arboretum, Professor Sargent, as stating that no plant collection can be worthy of scientific standing unless it has associated with it a first-class herbarium and a library. "There can be no doubt of their importance," says Mr. Wister, "even if the point of view of this Foundation . . . is that of the practical gardener and not of the scientific botanist."

"Fundamentally," as he truly says, "the two points of view are, or should be, one," and I was gratified to read, with whole-hearted approval, his further statement that the Arthur Hoyt Scott Foundation "should be and is as much interested in scientific achievement as are any other botanical gardens."

As every one knows, we are now living in a most terrible period of the world's history. We are engulfed in a world revolution. It is a revolution of annihilation. Its aim, partially accomplished, is the obliteration of every moral, religious and educational standard and value. The civilization of human freedom and opportunity, into which you and I were born and with which we have been familiar all our lives, is threatened with extinction. Much of the old will permanently pass away, but everything possible of value must be salvaged from the old and incorporated into the new civilization to come.

These values have been stated so recently and so frequently that it is not necessary to enumerate them here. They include the advancement and diffusion of knowledge, of a love of truth and beauty, and a freedom to cultivate whatever emancipates the spirit of man from all that is sordid and base, from ignorance and superstition.

The only war of aggression that was ever fought to attain these ends has been waged by our churches, our institutions of science and art, our schools and colleges, our museums and botanic gardens—not by guns and bombs, but by the method of St. Paul, of overcoming evil with good, ugliness with beauty, ignorance with knowledge. What a privilege it is to be free to have some part, however small, in leading the coming generations in America toward a higher and still higher type of Christian civilization. Said Lord Tweedsmuir, in his autobiography, "Politics is still the greatest and most honorable adventure." We agree with this with one exception; for "politics" we would substitute the word "education."

THE SMITHSONIAN INSTITUTION AS AN ILLUSTRATION OF INTERNATIONALISM IN SCIENCE[1]

By Dr. CHARLES G. ABBOT

SECRETARY OF THE SMITHSONIAN INSTITUTION

ON October 23, 1826, James Smithson, the natural son of Hugh, Duke of Northumberland, and of Elizabeth Macie, a lineal descendant of King Henry the Seventh, made his will. It contained this provision: "In the case of the death of my said Nephew without leaving a child or children . . . I then bequeath the whole of my property . . . to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an Establishment for the increase & diffusion of knowledge among men."

This provision became effective on June 5, 1835, and became known at our State Department in September, 1835. President Jackson announced the matter to Congress in December. Senators Calhoun and Preston of South Carolina strongly opposed acceptance, but Senators Jefferson Davis of Mississippi and Leigh of Virginia recommended it, and after some months prevailed. In the House, ex-President John Quincy Adams was a strong advocate, and secured the approval there. On July 1, 1836, the President approved the bill of acceptance, and at once sent Richard Rush of Philadelphia to England to prosecute the claim in the Court of Chancery. Through Rush's tact and diligence and through the aid of English friends, the mission was accomplished in two years, notwithstanding that in those days chancery suits sometimes began with a man's lifetime and their termination became a feature of his epitaph.

On May 9, 1838, the Court of Chancery handed down its epoch-making decree adjudging the Smithson bequest to the United States. Mr. Rush sailed with the gold in the packet ship "Mediator" and deposited £105,000 at the United States Mint in Philadelphia on September 1, 1838.

Eight years later, after prolonged debates in Congress regarding this unprecedented gift, the Smithsonian Institution was founded by the enabling act approved August 10, 1846.

The Institution is the ward of the Government. It is governed by a Board of Regents comprising the Vice President, the Chief Justice, three Senators, three Representatives and six eminent citizens. Their Secretary is the Executive Officer.

The Regents were particularly happy in selecting Professor Joseph Henry of Princeton, the eminent discoverer in electricity, to be their first secretary. He conceived the plan of operations which has been followed for nearly a century, which has made the Institution honored throughout the world, and highly useful to the people and Government of the United States.

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[1] World-wide broadcast of the American Philosophical Society and WBUL, Philadelphia, May 15, 1942.

Briefly, the plan is to increase knowledge by doing original research in fields not fully cultivated elsewhere, and by making grants, as means permit, to investigators who show promise. To diffuse knowledge, the Institution publishes its own researches and occasionally those of others, and distributes its publications without cost to about 1,500 libraries and specially interested individuals all over the world. It also collects each year and publishes in the original or in translation, as the Appendix to its Annual Report, about 25 articles from sources not generally available, including foreign as well as domestic authors, and even preferring to use foreign sources difficult of access here. These articles are chosen to set forth in simple but accurate terms the outstanding news in scientific discovery, so that non-specialist readers can understand what's worth while and follow the chief advances in science.

Besides these publications, the Institution, in further diffusion of knowledge, conducts a zoological park and several museums of art, industry, history and natural history which are visited by two and one half millions of people annually. It also gives information by letter to many thousands of inquirers each year, sponsors a weekly half-hour radio program, "The World is Yours," and gives occasional lectures. It originated and still administers the International Exchange Service, through which our Government and many American institutions exchange parliamentary proceedings and scientific documents with countries in all parts of the world.

The Institution has sent exploring and collecting parties to all the continents and most of the islands, and its correspondence and distribution of publications is very copious and equally far-reaching. Exchanges have built up the Institution's scientific library to three quarters of a million items, and these it has loaned to the Library of Congress, in order to extend their usefulness.

For some years the Institution had in its hall a column of books, 4 books square and 23 feet high, which were all Smithsonian research publications. The label truly informed the visitor that hardly a textbook or an encyclopedia or scientific work of recent times exists which does not make use of knowledge recorded in these volumes.

Such is the Institution of world-wide influence for culture, useful knowledge and peaceful aims which was set up by that scientific statesman, James Smithson. A less far-sighted man would have made his bequest solely to relatives, or at the best to some charity in his native land. But Smithson was interested unselfishly in the advancement of all mankind through knowledge, and wonderfully has his bequest succeeded in promoting his ideal.

Those of us who can look a little backward through the years to the times before the first world war, recall the happy state of international relations. A traveler then could go almost throughout the world without a passport. Discoveries, without regard to their money value, were published in the language of their author, and distributed to scientific readers everywhere. Complete faith in the honest intentions of all scientific research workers was the rule. Results obtained in one country were used as the basis on which to build further knowledge in all. Such was the attitude of mind which was then prevailing in scientific circles, and under such genial conditions knowledge increased by leaps and bounds.

Think of the development of electricity from Faraday and Henry, about 1830, to include the dynamo and the street car. Remember Edison and the electric light. Recall Henry and Morse and the telegraph; Bell and the telephone; Hertz and Marconi and the radio. Household conveniences multiplied, such as fans, toasters, refrigerators, bells and hosts of others. Think of Röntgen and the x-ray and its use in surgery; of Pasteur and antisepsis; of preventive medicine with its engineering sanitary aids all unknown in Smithson's day. Think of the astonishing progress in the chemistry of carbon, leading to medicines, plastics, colors, gas and gasoline. Think of the Curies and radium leading to the intimate study of the structure of the atom. Think of Einstein and relativity bringing a new philosophy to be the complement of that of Sir Isaac Newton. Here we see men and women of many countries in a united friendly effort, giving all mankind new thoughts and new conveniences, prolonging life and enriching it.

That was the vision to which James Smithson devoted his fortune. It has not only accomplished much directly through the Smithsonian Institution, but Smithson's deed has become so well known that it has led many others in many countries to emulate him in founding research institutions, and in helping to increase and diffuse knowledge without narrow or selfish limitations.

A notable instance is the establishment of the Nobel prizes. Alfred Bernhard Nobel was a Swedish chemist and engineer who devoted himself to the improvement of high explosives. He amassed great wealth in connection with the development of the Russian oil fields. Dying in 1896, he left most of his fortune to establish five large prizes to be awarded by certain Scandinavian agencies without regard to the nationality of recipients. The first three prizes are awarded for eminence in physical science or physiology. The fourth is for the most remarkable current literary work of an idealistic tendency. All hail to the fifth! It is given to the person or society that renders the greatest service to the cause of international brotherhood, in the suppression or reduction of standing armies or in the establishment or furtherance of international congresses to promote peace. Numerous Nobel prizes have been given and to representatives of many countries.

The friendly relations which prevailed among all nations, before the world wars of this century, fostered and were fostered by the international societies which grew up among the eminent men of science in each of its principal branches. Every science from astronomy to zoology, throughout the alphabet, had its occasional congresses held in turn in the different nations. Fast friendships were formed across the seas. It was inspiring to meet the eminent discoverers, whom one had grown to admire through their published works, to be found in the scientific libraries of all nations.

These congresses took up world problems in science, assigned suitable parts to the several nations harmonious to their opportunities, and thus astonishing progress often followed, far beyond what individuals could have done without organized cooperation.

In recent time we lament to see a reaction against this friendly policy of Smithson and of Nobel. Germany fifty years ago was revered as a world's leader in culture. American students who wished to be liberally educated went by thousands at great financial sacrifice to enjoy the benefit of the invigorating German scientific atmosphere. But now, we are informed, not only are illustrious Germans like Einstein obliged to fly from their country, but science, art, religion and truth itself are warped and emasculated so as not to appear to contradict the cruel and hateful policy of the German rulers. All information is censored and death is the penalty for listening to the news broadcast from other nations. In conquered countries the Germans seek to exterminate culture and reduce the inhabitants to slavish status. Our lines have run into very dangerous times. Truth is gravely threatened. Free peoples everywhere emulate one another in the sacrifice of their dearest possessions to preserve for the world the Smithson ideal of altruistic increase and diffusion of knowledge among all men.

SCIENTIFIC EVENTS

DEATHS AND MEMORIALS

DR. FRANCIS RAMALEY, professor of biology emeritus of the University of Colorado, botanical editor of *Ecology*, died on June 10, in his seventy-second year.

DR. ROY K. FLANNAGAN, medical director of the department of public health of Virginia, died on June 18, at the age of seventy-one years.

DR. LAURENCE S. MOYER, of the department of botany of the University of Minnesota, was killed recently in a blimp accident near Atlantic City while on a mission for the Navy.

DR. WILLIAM A. BRYAN, director of the Los Angeles Museum of History, Science and Art, died on June 18, at the age of sixty-six years.

DR. A. R. FORSYTH, emeritus professor of the Imperial College of Science and Technology, London, died on June 2, at the age of eighty-four years.

Nature reports the death of Professor Charles Cohen, formerly of the Pasteur Institute, Brussels, aged sixty-one years; of Dr. John Miller, director of aircraft production (factories), formerly chief engineer, London and North-Eastern Railway; of Professor G. A. Witherington, formerly of the department of mathematics in the Royal Naval College, Greenwich, aged sixty-nine years, and of Dr. Bernhard Fischer-Wasels, professor of morbid anatomy at Frankfort-on-Main, president of the German Pathological Society and editor of the *Frankfurter Zeitschrift für Pathologie,* at the age of sixty-five years.

IN connection with the seventy-fifth anniversary celebration of the founding of the Torrey Botanical Club, the department of botany of Columbia University observed the fiftieth anniversary of its organization as a separate department of the university and the one hundred fiftieth anniversary of the appointment of the first professor of botany in Columbia College, then at Astor Place in lower Manhattan. Dr. Richard S. Kissam was appointed to the chair of botany on February 20, 1792, and was thus the third designated professor of botany in America, being preceded in point of time only by Adam Kuhn in 1768 and Benjamin Barton in 1789 at the College of Philadelphia. The department of botany was eventually organized a hundred years later as a distinct school at Columbia by Dr. Nathaniel Britton. In observance of these anniversaries an exhibit depicting the development of botany at Columbia was held in Low Memorial Library during the month of June.

GRASSLAND RESEARCH IN GREAT BRITAIN[1]

THE appointment of Sir George Stapledon as the director of the Ministry of Agriculture Grassland Improvement Station, Dodwell, marks a break in a long period of pioneer service which may be said to have revolutionized the current methods of grassland management. After holding the posts of professor at Cirencester and adviser in agricultural botany at Aberystwyth, Sir George became the first director of the official Seed Testing Station when it was founded by the Food Production Department of the Ministry of Agriculture during the war of 1914–18. Thence he proceeded to the chair of agricultural botany at Aberystwyth and also became director of the Welsh Plant Breeding Station when it was founded in 1919. Gathering round him a band of enthusiastic and patient research assistants, he began the long series of experiments which have made his work famous the world over.

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[1] From *Nature*.

So early as 1913 Sir George was interested in pasture problems, such as drought resistance, and the response of grassland species under manuring, and in 1916 he collaborated with his present successor, T. J. Jenkin, in investigations on indigenous species in relation to habitat and sown species. For the next twenty-five years his attention was devoted to the various ways in which the grasslands of Great Britain could be improved and better use made of the great acreage of unprofitable and neglected pastures up and down Great Britain. The importance of varieties and strains was fully recognized, and geneticists and plant breeders on his staff concentrated their attention on the production of the special types of the herbage plants needed for specific purposes. The labor involved was immense, and only by most skillful organization has it been possible to carry through the work without confusion or delay, and to apply the results to agricultural practice. Varieties of grasses and clovers have been bred for earliness or lateness, for leaf or stem production, for spreading or erect types, to provide seed to meet different requirements.

Parallel with the plant-breeding work, problems of management were investigated, particularly in relation to the effects of grazing, and the most amazing and valuable results were obtained. But all the time Sir George was working towards his main object of obtaining recognition from the government and farmers alike that poor or derelict pasture could be so improved as to become an important asset instead of a liability. Much preliminary critical work was carried out, the importance of buried and viable seeds in the soil being early recognized. Then in 1933 the station acquired Cahn Hill, whereon large-scale hill experiments could be made in order to develop methods whereby improvements could be made and to determine their economic value. Much progress has been made, both on the hill pastures and in connection with ley farming, in which poor permanent pasture is improved by ploughing up and reseeding. Sir George Stapledon's new appointment will provide an excellent opportunity to demonstrate the value of his ideas, backed by wide experience, and the venture will be followed with great interest by all who have the interests of agriculture at heart.

THE INSTITUTE OF AERONAUTICAL SCIENCES

An account is given in the *New York Herald Tribune* of the gift of the Daniel Guggenheim estate at Sands Point, L. I., to the Institute of Aeronautical Sciences for the establishment of a center for aeronautical research and study. The gift was made by Mrs. Guggenheim in memory of her husband, who during his lifetime gave several million dollars for the advancement of aeronautical sciences.

The Guggenheim estate, near Port Washington, L. I., contains 162 acres, with two thirds of a mile of shore front and a forty-room house overlooking Long Island Sound. It has been named Daniel Guggenheim Park by the council of the institute. A board of trustees will supervise arrangements for the use of the property and will appoint a board of scientific advisers to conduct aeronautical research. In accepting the gift from Mrs. Guggenheim, the institute consulted with her son, Lieutenant Commander Harry F. Guggenheim.

Daniel Guggenheim established the Daniel Guggenheim Fund for the Promotion of Aeronautics in 1926 with a gift of $2,500,000, which was subsequently increased. He previously had established the Guggenheim School of Aeronautics at New York University, and the fund endowed schools of aeronautics at the Massachusetts Institute of Technology, the Georgia School of Technology, the California Institute of Technology, the University of Washington, Leland Stanford University, Syracuse University and the University of Michigan. The fund also established a chair of aeronautics in the Library of Congress, made the first equipment loan in this country to establish aerial passenger service, set up the first complete aeronautical weather-reporting service and established a safety prize.

The Institute of Aeronautical Sciences, which now has headquarters at Rockefeller Center, was organized in 1932 and has forty-seven branches throughout the country and a library of more than 12,000 aeronautical publications.

AWARDS FOR EXHIBITS AT THE MEETING OF THE AMERICAN MEDICAL ASSOCIATION

At the ninety-third meeting of the American Medical Association in Atlantic City, gold, silver and bronze medals were presented by the committee on award of scientific exhibits. The awards in Group 1 were for exhibits of individual investigations, which are judged on the basis "of originality and excellence of presentation." Those in Group 2 were for exhibits "which do not exemplify purely experimental studies and which are judged on the basis of excellence of presentation and correlation of facts."

The awards in Group 1 were a gold medal to Drs. Eben J. Carey and Leo C. Massopust, Marquette University Medical School, for their studies showing why a person jumps at a flash of lightning, quivers in anticipation of danger or springs to defense in an emergency; a silver medal to Drs. Deryl Hart and Samuel E. Upchurch, Duke University School of Medicine, for an exhibit showing the use of electrical radiation in sterilizing the air of operating rooms; a bronze medal to Dr. O. V. Batson, Graduate School of Medicine, University of Pennsylvania, for his demonstration of the method by which cancer and other diseases spread through the body.

The awards in Group 2 were a gold medal to Drs. John C. Bugher and Manuel Roca-Garcia, of the National Department of Health, Bogota, Colombia, for their exhibit on the means by which jungle fever is spread by mosquitoes; a silver medal to Dr. Emanuel Libman, of the Mount Sinai Hospital, New York City, for his studies on heart disease; a bronze medal to Drs. L. M. Randall, M. C. Piper, L. A. Brunsting and M. B. Dockerty, the Mayo Clinic, for their work on cancer of the ovary.

Special "certificates of appreciation" were awarded to eleven exhibits from Latin-American republics. There were also a number of certificates of merit. Special certificates of merit were given to demonstrations on diabetes and the Kenny method for the treatment of infantile paralysis.

NEW YORK MEETING OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

THE fiftieth annual meeting of the Society for the Promotion of Engineering Education will be held on June 27, 28 and 29 at Columbia University. The entire series of meetings, discussions and addresses, under the presidency of A. H. White, will be devoted to the general subject, "The Task of the Engineering Colleges in the War Effort." The meeting this year is being held under the auspices of the twelve engineering colleges in the New York metropolitan region. Most of the meetings will be held at Columbia University, but on Monday various groups will visit other engineering schools for group discussions.

Registration will be at the Low Memorial Library on Friday night. The first general session will convene on Saturday morning. A. H. White, president of the society, will preside, with addresses of welcome by Dean Thorndike Saville, of the College of Engineering at New York University, chairman of the Engineering College Administrators of the New York Metropolitan Area; James K. Finch, associate dean, Columbia University, and J. S. Morehouse, chairman, Middle Atlantic Section of the society.

Joseph W. Barker, assistant to the Assistant Secretary of the Navy, will discuss at this session the Navy's need for engineers. Brigadier General R. C. Crawford, commandant of the Engineer School, Fort Belvoir, Va., will speak on "What the Engineering Schools are Doing and should Do to Further the War Effort." The enlisted reserve corps program of the United States Army, a new development under which college students may enlist in the army and qualify for commissions, will be discussed by Lieutenant Colonel C. E. Hixon, of the military personnel division of the Services of Supply. W. O. Hotchkiss will discuss the Army Specialist Corps, and Professor White will deliver his presidential address. Group conferences will be held on Saturday afternoon.

The second general session will open on Sunday at 10 A.M., at which time William L. Batt, director of materials of the War Production Board, will head a list of government officials in addresses concerning the war task of engineering colleges. Others on the program include Dr. Leonard Carmichael, director of the National Roster of Scientific and Specialized Personnel; Dr. Karl T. Compton, Office of Scientific Research; W. H. Kushnick, director of the Civilian Personnel Training, and F. J. Kelly, chief of the Division of Colleges and Professional Schools of the U. S. Office of Education. Following the addresses and discussion, new officers of the society will be elected.

The third general session will take place on Sunday afternoon at 2:30 P.M., when the speakers will include George W. Case, engineering, science and management defense training; A. M. Greene, special consultant to the War Production Board; D. B. Prentice, chairman of the committee on acceleration of regular engineering programs; and W. E. Wickenden, chairman of the committee on conservation of engineering students. The annual dinner will be held in the evening, when the award of the Lamme Medal will be made.

On Monday divisional meetings will be held at other engineering schools. Host institutions to the meetings, in addition to Columbia University, are the Polytechnic Institute of Brooklyn, Cooper Union, Manhattan College, New York University, the College of the City of New York, the Newark College of Engineering, Pratt Institute, Princeton University, Rutgers University, Stevens Institute of Technology and the Webb Institute of Naval Architecture.

SCIENTIFIC NOTES AND NEWS

The doctorate of science was conferred on June 16 at the commencement exercises of Princeton University on Dr. Richard Chace Tolman, professor of physical chemistry and mathematical physics at the California Institute of Technology and vice-chairman of the National Defense Research Committee, and on Childs Frick, honorary curator of late tertiary and quaternary mammals at the American Museum of Natural History and trustee of the museum.

Dr. George Harrison Shull, professor of botany and genetics at Princeton University, was awarded the degree of doctor of science at the commencement of the Iowa State College in recognition of his early research leading to the discovery of the scientific basis for hybrid corn.

The doctorate of laws was conferred on June 19 at the commencement exercises of New York University on Dr. Frederick P. Keppel, from 1923 to 1941 president of the Carnegie Corporation.

At the recent commencement exercises of the University of North Carolina Dr. William S. Tillett, professor and head of the department of medicine of the New York University Medical School, was awarded the honorary degree of doctor of science.

J. R. Van Pelt, head of the curatorial department of the Chicago Museum of Science and Industry since 1930, has received the honorary degree of doctor of science from Cornell College, in recognition of his contribution to better public appreciation of pure and applied science.

A testimonial dinner in honor of Professor Albert Ball, head of the department of physics at Cooper Union, who is retiring after thirty-seven years of service, was given on May 28 by forty-nine past and present members of the faculty at the Hotel Lafayette in New York City. A bound volume containing seventy-two letters of tribute was presented to him by George F. Bateman, dean of the Engineering School. Other speakers included Gordon Thompson, Class of 1909, chief engineer of the Electrical Testing Laboratory; Professor Harold W. Merritt, who becomes senior member of the department of physics, and Professor Ball. J. Charles Ridel, chief engineer of the New York City Board of Estimate and Apportionment, was toastmaster.

It is reported in the *Journal* of the American Medical Association that Dr. Jacob C. Krafft, clinical professor of pediatrics at the Loyola University School of Medicine, on May 13 was the guest of honor at a dinner given by the Northwest Branch of the Chicago Medical Society and by friends, in recognition of his many years of service in the profession and in special recognition of his work in the care of the mentally handicapped child. Dr. Krafft was presented with a sphygmomanometer.

Professor M. Greenwood, head of the department of epidemiology and vital statistics at the London School of Hygiene, has been elected an honorary fellow of the National Institute of Sciences of India.

The newly elected officers of the University of Southern California Chapter of the Society of the Sigma Xi are: Dr. Thomas Clements, *President* (geology); Dr. Arthur Wyckes Nye, *Vice-president* (physics); Dr. Sydney Duncan, *Treasurer* (engineering), and Dr. Francis Marsh Baldwin, *Secretary* (zoology).

Officers of the Association of College Geology Teachers have been elected as follows: *President,* Percival Robertson, of The Principia College; *Vice-president,* David M. Delo, of Knox College; *Secretary-Treasurer,* Katherine F. Greacen, of Milwaukee-Downer College.

Dr. Henry J. Masson, for twenty-five years a member of the faculty of the College of Engineering of New York University, has been appointed assistant dean of the college. Dr. Masson, who is now director of the graduate and evening divisions, is also chairman of the department of chemical engineering.

Dr. R. G. Gustavson, professor of chemistry at the University of Colorado, has been appointed dean of the Gradnate School, to succeed Dean O. C. Lester, who retires at the end of the summer session.

Dr. Walter L. Hard, assistant professor of zoology at the University of Maryland, has become assistant professor in the department of histology and embryology of the School of Medicine.

The *Journal* of the American Medical Association states that Dr. Leopoldo Luis Benedetti B., Panama, has been awarded a fellowship in pediatrics by the American Academy of Pediatrics, the training to be carried out at the College of Medicine of the University of Cincinnati.

Clyde W. Leaf, of the Girandau-Delawanna, Inc., has been appointed organic chemist in the chemical engineering section of the Armour Research Foundation.

Dr. R. A. Rogers, of the department of physics of Park College, Parkville, Mo., has been appointed by the Bureau of Aeronautics of the Navy Department Ground School instructor in physics, mathematics and meteorology.

Recent appointments in the office of the Medical Division of the Office of Civilian Defense include Dr. Dean A. Clark, since 1939 surgeon of the staff of the Division of Public Health Methods of the National Institute of Health, who has been appointed head of a hospital section organized to carry out the new program recently announced by the OCD and the Federal Security Agency. Dr. Clark will also be placed at the head of a new Emergency Medical Section in the Public Health Service, which will administer the program jointly with the Medical Division.

Dr. Charles Armstrong, senior surgeon of the Public Health Service and director of the division of infectious diseases of the National Institute of Health, is convalescing at Hamilton, Mont., from a severe attack of tularemia (rabbit fever). He was taken ill on May 25, a few hours after his arrival on an official visit to the Rocky Mountain Spotted Fever Laboratory at Hamilton.

Dr. Reginald Fitz, Wade professor of medicine in the School of Medicine of Boston University and member of the council on medical education of the American Medical Association, delivered on June 18 the commencement address at the College of Medicine of the University of Vermont.

In recording the honorary degree conferred by Franklin and Marshall College on Dr. William Henry Welker, his position was given as head of the department of physical chemistry of the University of Illinois. This should have read the department of physiological chemistry of the College of Medicine.

Nature states that an Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain has recently been formed. The main activities of the association will be to assist members in their professional work and interests, to represent them with the authorities, to promote contact and relations with British colleagues and to form a link with British scientific and technical institutions. Lectures, courses and discussions will be held and will give opportunities for the exchange of views and to discuss matters of mutual interest. It is hoped that the association may assure that better use is made of the knowledge and abilities of Austrian engineers, chemists and scientific workers who are anxious to assist in the war effort. The acting chairman of the association is Dr. F. Ehrenfest-Egger; inquiries should be sent to the honorary secretary, Mrs. K. Hilfreich, 133 Hatherley Court, London, W.2. Lectures are being given on the first Monday of each month. Every Monday, commencing June 1, at 7 P.M., a clubroom will be open for members of the association at the Austrian Center, where there will be opportunities to read technical periodicals and to meet other colleagues.

The Council of the British Institution of Electrical Engineers has made the following awards of premiums for papers read or accepted for publication during the session 1941–42: *Institution Premium* to J. M. Meek; *Ayrton Premium* to J. S. Forrest; *Fahie Premium* to Dr. W. G. Radley and E. P. G. Wright; *John Hopkinson Premium* to Dr. A. L. Williams and L. E. Thompson; *Kelvin Premium* to E. Colin Cherry; *Overseas Premium* to Professor K. Aston and M. V. Kesava Rao; *Extra Premiums* to Dr. A. H. M. Arnold, G. W. Bowdler, G. W. Bowdler and W. G. Standring, R. Davis, Dr. H. D. Einhorn and Professor B. L. Goodlet, Dr. Hackett and A. M. Thomas, E. A. Richards, V. Sia, R. C. Woods and A. S. MacDonald; *Installations Section Premiums* to L. J. Davies, H. R. Ruff and W. J. Scott (Crompton Premium), R. Grierson; *Meter and Instrument Section Premiums* to E. A. Burton, J. S. Forrest and T. R. Warren (Silvanus Thompson Premium), D. J. Bolton; *Transmission Section Premiums* to J. W. Leach (Sebastian de Ferranti Premium), W. Casson and F. H. Birch; *Wireless Section Premiums* to O. S. Puckle (Duddell Premium), Dr. D. C. Espley and D. O. Walter (Ambrose Fleming Premium), J. E. Thwaites and F. J. M. Laver.

The Army unit of the New York Hospital and Cornell Medical College has been called into service, and its personnel reports for active duty on July 15. As the Ninth General Hospital, the unit bears the same number as the New York Hospital in France, which cared for 15,000 men of the American Expeditionary Force in the last war. Fifty-five doctors, 120 nurses and a number of non-professional employees will leave the hospital for service with the detachment. Chief of the Surgical Service will be Dr. Ralph F. Bowers, attending surgeon, and the head of the Medical Service will be Dr. Bruce Webster, assistant attending physician, each with the rank of lieutenant-colonel.

The sum of $250,000 has been given by an anonymous donor to the Brush Foundation of Western Reserve University for research and education. The work will be under the supervision of Dr. William Walter Greulich, professor of physical anthropology and anatomy, director of the foundation.

The Laboratories of Nutritional Biochemistry of the Massachusetts Institute of Technology have been granted $12,300 by the Rockefeller Foundation to be used during the twelve-month period beginning on July 1. Under this grant research on development of emergency rations and food mixtures for armies and distressed populations under the direction of Professor Robert S. Harris will be continued. A similar grant was made by the Rockefeller Foundation last year.

MRS. ALEXANDER LOWY has established a fund in memory of her late husband, who for over twenty years was professor of chemistry in the University of Pittsburgh. This fund is to help students in the course leading to the degree of bachelor of science in chemistry or to the Ph.D.

THE two Lynn, Massachusetts, plants of the General Electric Company, employing 25,000 workers, received the Navy "E" on June 19 for excellence in turning out war equipment. The pennant was presented on the same day to the Bound Brook, N. J., plant of the Bakelite Corporation, which produces a synthetic electrical insulation.

Nature writes: "We understand that the trustees of Charles Darwin are considering disposing of original MSS of Darwin's which are in their care. These include the manuscript journal kept by Darwin during the voyage of the *Beagle* (1831–36) on which was based his 'Journal of Researches into the Natural History and Geology of the various countries visited by H.M.S. Beagle . . .'; Darwin's autobiography in his own handwriting with alterations made or suggested by Mrs. Darwin; the manuscript of 'The Effects of Cross- and Self-Fertilization in the Vegetable Kingdom'; the 1844 sketch of 'The Origin of Species,' and a large number of letters and miscellaneous material, most of which has been published. Although this material may contain little of strictly scientific value, it has an obvious interest to the historian of science as revealing the workings of Darwin's mind at different periods of his life, and it would be unfortunate if the material should be dispersed. Such documents should be preserved in a library where access to them can be had by students, and it is to be hoped that some benefactor of science, aided perhaps by the Friends of the National Libraries, or some similar body, may be able to secure them for that purpose."

AT the request of the British Minister of Agriculture, the National Institute of Agricultural Botany has set up a special Seed Production Committee the duty of which will be to take all possible steps to stimulate, coordinate and ensure home seed production. The chairman of the committee is W. Gavin, agricultural adviser to the Ministry of Agriculture.

DISCUSSION

POST-GLACIAL CLIMATIC AMELIORATION AND THE EXTINCTION OF BISON TAYLORI

THE extinction of the late glacial bison species or races variously assigned to *occidentalis, antiquus* and commonly of late designated as *Bison taylori,* has become a matter of more than ordinary interest to the archeologist. Followed on the time scale, as it is, by a closely related and still existing species, its possibilities as an index fossil are considerable. Unfortunately, as in the case of other Ice Age forms, considerable mystery has clothed its demise. Similar mystery attends the first appearance of *Bison bison,* the succeeding form.

Bison taylori has been reported associated with human artifacts over a wide area of the High Plains. In certain instances, however, the identifications were not based upon the evidence of skull characters which are, at the present time, the only diagnostic features carrying entire conviction. To date *Bison bison* remains have not been reported intermixed with the extinct species upon any of these sites, yet it is a reasonable assumption that the two species overlap at some point on the late Pleistocene or early Recent time scale.

Indeed, a recent assertion in Hibben's monograph on Sandia cave[1] as to the presence of a form "near but smaller than *taylori*" leads us to wonder whether a smaller type may not have existed contemporaneously in the southern regions—though the size range in both *Bison bison* and *taylori* is not sufficiently known to clarify the situation, a state of affairs which tends to vitiate evidence drawn from limb fragments alone.[2]

It has been intimated occasionally that climate could not have been a major factor in the extermination of the Pleistocene fauna[3] because these animals survived the great ice movements only to disappear at their close. In the case of certain northern forms, at least, this has always seemed to the present writer like a dubious and wilful inversion of a much more reasonable assumption; namely, that some species adapted to more boreal conditions were poorly adjusted physiologically to the climatic amelioration which attended the recession of the last ice sheet. This is not to assign climate a single role in the process of extinction. It is obvious, however, that under conditions of increased temperature, species contending for survival might undergo delicate alterations in ecological balance, due to reduced fecundity and vitality.[4] It might give, for example, to a more southern variety of otherwise similar habits, a chance to expand over the retreating range once held by a more rugged and cold-resisting form. Ultimately the latter might be bred out or replaced.

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[1] Frank C. Hibben, *Smithsonian Miscellaneous Collections,* 99: 33, 1941. See also the present writer's review of this work in *American Antiquity,* 7: 4, 1942 (in press).

[2] Interesting in this connection is the fact that Figgins and others have noted a greater spread in the horn cores of the existing species as one progresses from south to north. Indeed Figgins speculates on the basis of stratigraphic evidence that *Bison bison bison,* which he recognizes as the shorter-horned variety, has extended its range northward in more recent times. (J. D. Figgins, *Proceedings of the Colorado Museum of Natural History,* 12: 26, 28, 1933.)

[3] A. L. Kroeber, ''Conclusions: The Present Status of Americanistic Problems,'' Chapter 34, ''The Maya and Their Neighbors,'' Appleton-Century, New York, 1940.

Bearing upon this point, there exists a certain amount of data from scattered sources which the writer believes are worthy of some degree of attention and which he has not seen organized with this problem in mind. First and most importantly, we encounter information detailing the effects of hot dry climate upon northern European cattle whose bovidean affinities are not too remote to invite serious analogies with the extinct *Bison taylori.* This latter animal, slightly larger and undoubtedly heavier pelted than the existing buffalo, moved in a cooler and more humid world than the historic species. Almost certainly he was capable of enduring more difficult winters. What happened, then, when the ice fell back?

The information dealing with European cattle, to which we now proceed, suggests a tentative explanation. Though climate may influence animals indirectly through its effect upon pasturage, for example, experimenters with live stock have noted that for these animals "there are optimum climatic conditions under which they will develop and produce best within the limits of their inherent capacity."[5] Many observations testify to the reduced vitality of European cattle under higher temperatures both as to milk production and fertility. Exposure to strong sunlight in summer causes a higher respiration rate, and the rise in body temperature indicates increased difficulty in the reduction of body heat. It has been observed that in hot climates cross-breeding of European cattle with tropically adapted bovids strengthens and improves the strains, suggesting favorable genetic distinctions in the ability of the southern types to adjust to warmer conditions.

Now the available evidence upon *Bison bison* suggests that in terms of ruggedness of physique, the northern phase or variety *Bison bison athabascae* approached most closely to the extinct *Bison taylori* in size.[6] Can it not be reasonably suspected, then, that *Bison bison* may have existed originally as a southern variant which, by reason of greater adaptability to heat and perhaps more impoverished and less succulent grazing conditions, expanded its range in the closing Pleistocene or early Recent at the expense of its larger and less heat-resisting relative? The paleontologist Hay, as a matter of fact, suggested as long ago as 1913, albeit in the course of a somewhat cursory survey, that he had noted some skulls referable to *B. occidentalis* "which might be looked upon as illustrating the transition from *B. occidentalis* to the existing American buffalo."[7]

The taxonomy, the morphological distinctions or relationships between the late Pleistocene bisons have never been examined with satisfactory thoroughness. Differences of opinion exist as to the relationship of these with the living form which can only be elucidated by more thorough anatomical and statistical studies than now exist. Perhaps, however, some of the assignments of southern limb fragments found with the Folsom culture are not valid in the light of hints of sizes ranging within *B. bison* specifications or not indicated at all. At all events the writer's purpose will be attained if this discussion leads to a more serious examination of the whole problem. The range, the intergradation of characters (if such exist) between *B. bison, B. bison athabascae*[8] and *taylori* should help greatly in clarifying a situation which has archeological as well as paleontological implications. Such a study, be it observed, will have to consist of more than the recording of the measurements of an occasional fine bull, of whatever species, and will have to take account of a possible progressive specific change which began earlier in the South.

LOREN C. EISELEY

THE UNIVERSITY OF KANSAS

UNFERMENTABLE REDUCING SUBSTANCES IN MOLASSES

WHEN pure invert sugar is heated at P_H 4.5 over a period of ten weeks at 55° C, a considerable quantity of material is formed which is not fermented by bakers' yeast. From the unfermentable residue of sugar thus treated we have isolated a product with the following properties: It is acid to litmus, soluble in water and glacial acetic acid, and it vigorously reduces both Fehling and Tollens solutions and gives no positive murexide test. It melts with decomposition at 226.5° C.

Quantitative analysis:

C 45.11 per cent. H 6.67 per cent. N 8.57 per cent.
P 3.79 per cent.

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[4] Even the living species, as pointed out some years ago by Seton, in spite of its vast numbers was subject to enormous losses from prairie fires, floods and blizzards, which led Seton to comment that it could have done no more than hold its own in the struggle for survival. (Ernest Thompson Seton, "Life Histories of Northern Game Animals," Vol. I. Scribners. New York, 1909).

[5] A. O. Rhoad, "Climate and Livestock Production," *1941 Yearbook of Agriculture,* Washington, D. C., 1941, pp. 508–516.

[6] E. H. Barbour and C. B. Schultz, *Bulletin Nebraska State Museum,* 1: 435–436, 1936. Seton, *op. cit.,* p. 250. S. N. Rhoads, Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. for 1897, pp. 499–500.

[7] O. P. Hay, *Proceedings of the U. S. National Museum,* 46: 176, 1913.

[8] S. N. Rhoads (*op. cit.*) expressed the view that *B. b. athabascae* was taxonomically intermediate between *B. bison* and the most recent fossil species.

An empirical formula based on these values is

$$C_{30}H_{54}O_{18}N_{8}P$$

We have found organic phosphorus in commercially available distillery slops concentrates which would seem to confirm the belief that the above compound is essentially a yeast product.

F. W. Zerban
The New York Sugar Trade Laboratory
Louis Sattler
Brooklyn College

CONTRACT BETWEEN THE SHELL DEVELOPMENT COMPANY AND THE CONGRESS OF INDUSTRIAL ORGANIZATIONS

A satisfactory contract has been consummated between the Shell Development Company, Emeryville, California, and the Federation of Architects, Engineers, Chemists and Technicians (CIO) (Chapter 25). The contract was signed on May 25, 1942, at the conclusion of a mediation hearing in Oakland before Paul A. Dodd, public associate member of the National War Labor Board and professor of economics at the University of California at Los Angeles.

The following statement was given by Mr. J. F. M. Taylor, president of the company, and Mr. Marcel Scherer, international vice-president of the Federation of Architects, Engineers, Chemists and Technicians:

> The signing of a collective bargaining contract indicates remarkable progress in collective bargaining in this field. We look forward to setting high standards in labor-management relations which will result in furthering Shell Development's contribution to the war effort.

Some 275 laboratory, engineering and pilot plant technicians of the company will benefit from this agreement, which establishes a contractual basis for hours, working conditions and wages. The company recognizes the federation as the sole bargaining agent for the employes covered by the contract.

The contract provides for promotions based on merit, layoffs based on seniority, and time-and-one-half payment for required overtime work. Employees are protected against arbitrary discharge. In cases of dismissals for general inefficiency or low standards of work, warnings are given a reasonable period in advance in order to afford the employee an opportunity to correct them. A clause on hiring states that no person shall be discriminated against because of race, color, creed, nationality, sex or religious belief. Among the economic benefits gained under the terms of this contract is the acceleration of the rate of advancement within the existing wage scales. The agreement contains a maintenance of membership clause whereby the company recognizes the obligation of employees who are now members or may become members of the Federation of Architects, Engineers, Chemists and Technicians, to maintain themselves in good standing in the union for the duration of the contract.

The outstanding and unique feature of the agreement is the inauguration of a patent bonus plan, the benefits of which will be shared equally by all employees of the company. This plan will undoubtedly stimulate inventions among the employees and thus contribute largely to the war effort.

At the conclusion of the hearing Professor Dodd stated:

> Because of the high intelligence and education of the negotiators on both sides of the table, it has struck me that this case is one of the most unusual cases to come before the War Labor Board. I am sure that the enlightened spirit which has prevailed at this conference table will be continued with a resulting satisfactory bargaining relationship.

David E. Adelson

THE STATURE OF MEN

In the May 22, 1942, issue of Science there appeared a communication (on page 529) from S. L. Calhoun, of Leland, Mississippi, mildly scolding a collaborator and myself for our promulgation of a "false hypothesis." This correspondent writes in part as follows:

> Recent articles in Science have left the reader with a certain amount of skepticism as well as a large amount of thought-provoking data.
>
> In the December 12 issue of Science (Vol. 94, No. 2450, pp. 552–553) Leonard R. Rowntree gives an average height of over 2,000,000 registrants examined as 67½ inches, the identical average of men in World War I. An increase in weight of eight pounds was shown.

Your correspondent then goes on to cite an article written by Richard G. Canning and myself which appeared originally in *Human Biology*, Vol. 13, No. 4, pp. 533–540, December, 1941, and which was discussed in Science, Vol. 95, No. 2454, *Supplement*, p. 13, January 13, 1942. We had shown that freshmen in the University of Cincinnati had increased over two inches in average height from 1916 to 1936. We had generalized from our data that men were getting taller. It seems that we had no right to do this, for your correspondent says:

> These observations would lead one to conclude that childhood care and advantages, which result in increased growth, are much greater for those students in the University of Cincinnati than for the United States as a whole, and that any conclusions drawn by Chenoweth and Canning should be confined and not generalized.

I think the explanation of the difficulty is a simple one. I have before me Medical Statistics Bulletin No. 1, National Headquarters, Selective Service System, Washington, D. C., November 10, 1941. This bulletin was prepared by Lieutenant Oliver Harold Folk, chief, Medical Statistics Section, Research and Statistics Division, under the direction of Mr. Kenneth H. McGill, assistant chief, Research and Statistics Division, and in cooperation with Colonel Leonard George Rowntree, M.C., Res., chief, Medical Division. On page six there appears this statement:

> The average height of the registrants examined (by local draft boards) was 67.5 inches, the average weight 150 pounds and the average chest measurement at expiration was 33.9 inches. Registrants who were classed by local boards as available for general military service averaged 68.1 inches in height and weighed 152 pounds.

On page eight of this report there also appears this statement:

> While many obvious reasons make direct comparisons with data compiled in previous emergencies impossible, it is interesting to note that the average height of recruits examined during World War I was 67.5 inches, the average weight was 142 pounds, and the average chest measurement at expiration was 33.2 inches.

What happened in Colonel Rowntree's analysis was, I think, that he had compared (1) a group of 2,000,000 men examined by draft boards in World War II with (2) *recruits*, or the men accepted by the army for military service in World War I. It must be remembered that all those less than 64 inches are not eligible for military service and were probably excluded from group (2) above, but were included in group (1). Hence we do not have here two comparable groups. The reason I feel this to be true is that the report specifically stated that *recruits* were 67.5 inches tall and recruits, according to army definition, are men *accepted* for military service who have not been assigned to a specific duty. It is quite true that men over 78 inches tall were also rejected, but every one knows that there are many more under 64 inches than over 78 inches.

You will notice from the report that, "Registrants who were classed by local boards as available for general military service averaged 68.1 inches in height. . . ." I have an idea that when the army reexamined these "registrants" and made "recruits" of them the average height of the latter increased some more. When the final figures are released I shall be surprised if we do not learn that the soldier in the Army of the United States in this present war is about one inch taller than his father was in World War I, provided the standards of height remain the same for both wars.

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SCIENTIFIC BOOKS

THE LYMPHATIC SYSTEM

Lane Medical Lectures: The Lymphatic System. Its Part in Regulating Composition and Volume of Tissue Fluid. By CECIL K. DRINKER, professor of physiology and dean of the School of Public Health, Harvard University. 101 pages; 29 illustrations. Stanford University Publications, University Series. Medical Sciences, Volume IV, No. 2. California: Stanford University Press, Stanford University. London: Oxford University Press, Humphrey Milford. 1942. Paper, $1.50; cloth, $2.25.

DESERVING a place as a medical classic beside Sir Michael Foster's Lane Medical Lectures on the "History of Physiology," published 42 years ago, are Dr. Cecil K. Drinker's lectures on "The Lymphatic System," for these few pages offer a most significant general account of the system.

All the five lectures are based on one theme—how do the blood capillaries and the lymphatic capillaries cooperate to produce the environment necessary for the life of every single cell in the animal body? For this function, Dr. Drinker finds that there are five essential features of the vascular system in mammals.

> 1. A closed system of blood capillaries with endothelial walls of varied permeability but capable of retaining practically all of the blood plasma during the usual conditions of rapid capillary transit.
>
> 2. A variable hydrostatic pressure in the capillaries.
>
> 3. A mixture of extracellular non-respiratory proteins in the blood to which the capillary endothelium is somewhat permeable.
>
> 4. An extravascular tissue fluid, lower than the blood plasma in content of blood proteins but in other respects practically identical with plasma.
>
> 5. A system of closed lymphatic capillaries with extremely permeable endothelial walls, which lacks any inherent propulsive mechanism to move lymph into larger valved vessels but is dependent upon inconstant and extraneous forces, such as those of muscular activity or massage, to cause entrance of fluid, cells, and particles into lymphatic capillaries and eventual flow of lymph back to the blood.

In the light of these characteristics which, in their entirety, are limited to the blood and lymph vessels of mammals, Dr. Drinker follows the changes in the environment of cells, from the very simplest forms for which sea water constitutes the external environment, through one shift or another in the animal kingdom—not in any sense through an orderly progression

—until in mammals all cells live in an internal environment. This makes a fascinating story.

There follows an account of the history of knowledge of the vascular system, written as one has longed to have medical history recorded. In these pages familiar discoveries are lived through again but, more than that, there is the continued logical story of the ideas they evoked—the history of medical thought.

It was a favorite saying of the late Professor Franklin Paine Mall that one ought to get just as much pleasure out of the discoveries of others in one's field as from one's own work. He would have found that quality of pleasure in Dr. Drinker's pages.

In Chapter IV is concentrated the story of the physiology of the lymphatic capillaries. It starts with the work of Carl Ludwig and his pupils. They succeeded in cannulating not only the thoracic duct but the peripheral lymphatic trunks as well. From his studies Ludwig believed that lymph was a filtrate from the blood, a concept later extended and established by Starling (1893) in a study of the influence of mechanical factors on lymph production. From this foundation further progress has depended on the development of exceptional skill in operative procedures, aided by the new binocular dissecting microscopes, adequate lighting facilities and tools perfectly adapted to their use. In addition, an essential factor in the advancement of knowledge in this field was the introduction (started in 1920) of microchemical methods which allowed for the first time repeated analyses of lymph from the same vessel.

By means of extensive experiments, notably by Dr. Drinker and his collaborators, on cannulating peripheral lymph channels, it has been demonstrated that in the entirely quiescent state there is practically no flow of lymph. This is expressed in the fifth generalization quoted above, that the lymphatics in the mammal have no inherent propulsive mechanism for moving the lymph.

The importance of this physiological fact is shown in its applications to medicine and surgery in the last chapter. There followed the even more remarkable achievements of cannulating the ducts draining the heart and the lungs. The studies on the lungs[1] were in press when the present Lane Lectures were being written. From both heart and lungs there is a considerable flow of lymph, relatively constant for each animal. Neither heart nor lungs are ever quiescent. Over-ventilation of the lungs reduces lymph flow and, conversely, lowered oxygen, by increasing the permeability of the blood capillaries, increases lymph flow. From the lungs, a single lymphatic duct on the right side drains the right lung and much more than half of the left lung, but from the heart, on the other hand, it is possible to collect all the lymph. Analyses of the lymph from the heart and of the pericardial fluid show such correlation in composition with serum as to demonstrate conclusively that both lymph and pericardial fluid are filtrates from the blood.

Based on the knowledge gained from extensive experiments on lymph flow and the conditions which affect it, is such an illuminating discussion (in the fifth chapter) on the mechanisms of wound healing and scar formation in relation to the newer methods for treating injuries that no surgeon can afford to miss it.

At the time Dr. Drinker was invited to deliver the Lane Medical Lectures for 1941, he was engaged in correcting proof of his recent book[2] which gives a detailed, critical analysis of the entire subject and an extensive bibliography. This invitation gave him a chance for a different type of contribution. These are days of high specialization in science, but the type of problem that must now be faced demands not one but often many of these special techniques. Books of the type of the present one, which give the story of the nature of a problem and of the balance of theory and experiment, are thus urgently needed by scientists themselves. Written in clear, lucid, nontechnical language, these pages will prove a delight to the layman interested in biology, to the medical student keen to see what the adventure of research is like, and to the practitioner, still a student of medicine.

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A MODERN WIZARD

Doctor Wood: Modern Wizard of the Laboratory. By WILLIAM SEABROOK. 335 pp. New York: Harcourt, Brace and Company. 1941. $3.75.

THOSE who have known Dr. Wood for many years will doubtless read with much enjoyment, not to say amusement, this very interesting biography. In it they will find many verifications of their own experiences and many additions to those experiences. Naturally, it is impossible to give anything like a detailed review of a book which is saturated with anecdotes and in which the details of the special situations concerned are the things which provide the main features of entertainment.

The biography starts with a legendary letter supposedly written by Robert Williams Wood to his grandmother on the day he was born and announceing his intention of paying his respects to the said grandmother in due course. Chapter I introduces us to some of his boyhood pranks, which read much more amusingly when the dangers and embarrassments associated with them are known to have passed. In Chapter 2 we trace his four years at Harvard, we breathe a sigh of relief at the evident intervention of Providence which prevented him from blowing up the chemical laboratory, we find him transporting himself into the realms of fantasy through an effort to enlarge his experience by swallowing a suitable quantity of oriental drugs and thus transforming himself in his own imagination into a fox, and finally we see him safely graduated in 1891, to the relief and surprise, as it is recorded, of his family and probably some of the faculty as well, many of whom, it is confessed, he must have infuriated beyond words. *In the third chapter we find him at* Johns Hopkins with the idea of securing a Ph.D. degree. We see him spitting out metallic sodium into street puddles to the great consternation of the darkies who, seeing him thus spit that which turns to fire, believed him to be a reincarnation of the devil himself. We read of his courtship of the future Mrs. Wood and of its practical turn in devising a specialized form of hot water bottle, depending upon a mixture of sulfuric acid and water, for the purpose of keeping her hands warm. We find him leaving Johns Hopkins without the degree for which he went there and going to the University of Chicago, where we learn of his grievances in the laboratory of Professor E. H. Schneider, from whom, however, he parted without mortality on either side. He completes his thesis for his Ph.D. degree in chemistry, but changes in the requirements in physics prevent him from completing that degree and result in his leaving in high dudgeon. Next we find him in Berlin where, as a result of some of his pranks, only his legs save him from official incarceration as a guest of the government. We find him trying out everything, including gliding, and nearly breaking his neck in the process. In 1897 he assumes the academically humble and poorly paid post of junior instructor of physics at the University of Wisconsin, where, however, advancement comes to him for his ingenious exploit in using the city's electric power supply to thaw out the city's water mains in winter. Later, in the same university, we find him beginning some of the spectroscopic work for which he was to become so famous.

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[1] Madeleine F. Warren and Cecil K. Drinker, *Amer. Jour. Physiol.*, 136: 207, 1942.

[2] C. K. Drinker and J. M. Yoffey, "Lymphatics, Lymph and Lymphoid Tissue." Cambridge, Mass.: Harvard University Press, 1941.

Following the death of Henry Roland in 1901, Wood became professor of experimental physics at Johns Hopkins University where, supplemented by the work performed at his summer laboratory at East Hampton, he continued to enhance his reputation so well established in optics. The narrative is filled with anecdotes pertinent to this period, one of the most celebrated being that concerned with the cleaning of cobwebs from the interior of his long spectroscope, which action was performed by driving the family cat through the tube, a procedure which, as one might surmise, he did not fail to publish in the *Philosophical Magazine*. We read of his trips to Europe, of his subtle tiffs with certain Continental physicists and of his dramatic and perhaps a little hard-hearted procedure of exposing the myth of Blondlot's N-rays. We read of the background surrounding his humorous writings, notably his celebrated book "How to Tell the Birds from the Flowers." The war period is covered, and one senses that Wood's temperament was evidently not very well adapted to military procedures. We read of his exploits in the debunking of frauds and of his driving the celebrated medium, Margery, into hysterics. We learn of his exploits in the capacity of a scientific detective and of his solution of several criminal mysteries. Finally, we learn of his exploits as a boomerang thrower and of his confidence of his own skill in hurling a war boomerang right at the spectators of a football match, happily without fatality.

All in all, the book will provide entertaining reading for any one and particularly for those who have known Dr. Wood in the flesh and who, of their own experience, can enhance the setting of some of the amusing stories told.

W. F. G. Swann

Bartol Research Foundation of
The Franklin Institute

SOCIETIES AND MEETINGS

THE IOWA ACADEMY OF SCIENCE

The fifty-sixth annual meeting of the Iowa Academy of Science was held at Iowa Wesleyan College, Mt. Pleasant, Iowa, on April 17 and 18, with 195 registered members and visitors attending. The academy was officially welcomed to the Iowa Wesleyan campus by President Stanley B. Niles, who at the same time reviewed the history, accomplishments and objectives of Iowa Wesleyan College, which was celebrating the centenary of its founding. The presidential address by President Roy A. Nelson, of Cornell College, following the welcome, ably developed the topic "Science in a Changing World." Then Dr. Walter F. Loehwing, of the State University of Iowa, presented an interesting discussion of the physiology of plant growth and development.

A joint symposium on industrial hygiene was held with the Iowa Medical Society on Friday afternoon.

The topic "Industrial Hygiene Problems in Iowa" was discussed by Dr. Paul J. Houser, director of hygiene, Iowa State Department of Health; "Air-Borne Infection," by Dr. Roland Rooks, of the Department of Hygiene and Preventive Medicine, State University of Iowa. There were 128 paid admissions to the academy dinner on Friday night. After dinner Dr. Thomas F. Vance, of Iowa State College, made a sparkling address on "Sense and Nonsense Amid the Scientific." The academy address of Friday night was delivered by Dr. George E. Stoddard, of the State University of Iowa, on the subject "New Light on Intelligence," a review of recent work on the "Nature-Nurture" problem.

The academy met as usual in sections on Friday afternoon and Saturday morning to listen to the presentation of 123 papers. Three of these papers appeared in the symposium of the Science Teaching section. The speakers and subjects were as follows: E. W. Lindstrom, Iowa State College, "Teaching to Think *in* a Field Rather than *about* It"; W. H. Bragonier, Iowa State College, "The Use of the Standard Partial Regression Coefficient in Constructing General Botany Achievement Tests"; W. F. Loehwing, State University of Iowa, "Teaching of General Botany—Appraisal and Forecast."

The 1943 meeting will be held at Cedar Falls, Iowa, on the third Friday and Saturday of April. The officers and section chairmen for the new year are as follows: *President,* C. W. Lantz, Cedar Falls; *Vice-President,* E. R. Smith, Ames; *Secretary-Treasurer,* E. R. Becker, Ames; Editor, L. R. Wilson, Cedar Rapids; botany, W. E. Loomis, Ames; chemistry, general and physical, D. L. Deardorff, Mt. Pleasant; chemistry, organic and biological, F. B. Moreland, Iowa City; geology, E. J. Cable, Cedar Falls; mathematics, N. B. Conkwright, Iowa City; physics, L. T. Earls, Ames; psychology, H. F. Brandt, Des Moines; science teaching, Karl A. Stiles, Cedar Rapids; zoology, Leland P. Johnson, Des Moines.

E. R. BECKER,
Secretary

AMES, IOWA

REPORTS

REGULATIONS CONCERNING LABORATORY EQUIPMENT

THE Division of Industry Operations of the War Production Board has issued the following regulations in regard to the manufacture and use of laboratory equipment:

> Because of the critical shortage of scientific equipment, university and other private laboratories engaged in research work unrelated to the production of materials, or in other research not directly connected with the war effort, will be unable to secure new laboratory equipment unless the particular use is approved by the Director of Industry Operations.
>
> This is the result of Limitation Order L–144, issued to-day (June 12). The order prohibits the sale and delivery of laboratory equipment except for certified essential uses in order to save highly critical materials and to make certain that such equipment will be available for vital war purposes.
>
> In addition to making special provision for the handling of requests for equipment for uses not specifically permitted, the order permits any laboratory or other user to obtain repair parts and operating supplies for maintenance of existing equipment and activities.
>
> The regulations, which will affect 600 manufacturers and 3,000 laboratories, prohibit the sale, delivery, renting or purchase of laboratory equipment in which any of the following materials are contained: aluminum, chromium, copper, iron, magnesium, molybdenum, nickel, steel, tantalum, tin, titanium, any alloy of these metals, rubber, any synthetic rubber, or non-cellulose base synthetic plastics.
>
> In order to buy or sell laboratory equipment containing the above materials, a certification must be made by a duly authorized official of the purchasing company or laboratory stating that the equipment will be used only for one of the following purposes:
>
> 1. Research on, or analysis of, materials.
> 2. Research by or for Government agencies or "Lend-Lease" countries.
> 3. For training of personnel for the Army and Navy or other Government Departments or "Lend-Lease" countries.
> 4. To the extent necessary for the replacement of essential existing equipment in laboratories affecting the public health, and in Federal, State and local government laboratories.
> 5. To the extent necessary for repair parts and operating supplies for maintenance of existing essential equipment and activities in laboratories.
> 6. For any use which the Director of Industry Operations determines necessary and appropriate in the public interest.
>
> Determinations of the uses which will be permitted under item (6) will be made by E. R. Schaeffer, Chief of the Safety and Technical Equipment Branch, acting for the Director of Industry Operations. Mr. Schaeffer has been named Administrator of the L–144 Order, and authorized to approve, after consultation with the Army and Navy Munitions Board, further uses of laboratory equipment which may be necessary.
>
> Manufacturers will obtain the necessary amounts of critical materials for purposes permitted by the order by filing PD–25A applications under the Production Requirements Plan. Distributors, wholesalers and jobbers

needing priority assistance should file PD-IX forms with the Distributors Branch of the War Production Board.

TITLE 32—NATIONAL DEFENSE
CHAPTER IX—WAR PRODUCTION BOARD
SUBCHAPTER B—DIVISION OF INDUSTRY OPERATIONS
PART 1261—LABORATORY EQUIPMENT
LIMITATION ORDER L–144

The fulfilment of requirements for the defense of the United States has created shortages in the supplies of Laboratory Equipment and the materials entering into the manufacture thereof for the war effort, for private account and for export; and the following Order is deemed necessary and appropriate in the public interest and to promote the national defense:

Section 1261.1—GENERAL LIMITATION ORDER *L–144.*

(a) *Definition.* For the purpose of this Order:

"Laboratory Equipment" means material, instruments, appliances, devices, parts thereof, tools and operating supplies for laboratories, or for use in connection with operations usually carried on in laboratories, not including second-hand items.

(b) *General Restrictions.*

(1) No Person shall sell, deliver, rent, purchase, acquire or accept delivery of Laboratory Equipment in which there is incorporated or used aluminum, chromium, copper, iron, magnesium, molybdenum, nickel, steel, tantalum, tin, titanium, any alloy of said metals, rubber, neoprene or other synthetic rubber, or non-cellulose base synthetic plastics, except pursuant to a purchase order or contract having certified thereon a statement in the following form, signed manually, or as provided in Priorities Regulation No. 7, by an official duly authorized for such purpose:

"Certification

The Laboratory Equipment herein ordered will be used or sold in conformity with the provisions of General Limitation Order No. L–144, with the terms of which the undersigned is familiar.

Name ....

By ....

Signature of duly authorized official"

(2) No person shall make the Certification described in the foregoing paragraph unless the Laboratory Equipment purchased or contracted to be purchased is for one or more of the following uses:

(i) Research on, or production, analysis or testing of, materials.

(ii) Research by or for the United States Army, Navy, Maritime Commission, or any other department, or agency of the government of the United States, or of any foreign country entitled to deliveries under the Act of Congress of March 11, 1941, "An Act to Promote the Defense of the United States" (Lend-Lease Act).

(iii) Training of personnel for the United States Army, Navy, Maritime Commission, or any other department of the United States, or for the government of any foreign country entitled to deliveries under the Act of Congress of March 11, 1941, "An Act to Promote the Defense of the United States" (Lend-Lease Act).

(iv) To the extent necessary for the replacement of essential existing equipment in laboratories affecting the public health, and in United States government, state, county, and municipal laboratories.

(v) To the extent necessary for repair parts and operating supplies for the maintenance of existing essential equipment and activities in laboratories.

(vi) For any use which the Director of Industry Operations, War Production Board, determines is necessary and appropriate in the public interest.

(3) Said Certification shall constitute a representation to the War Production Board and to the person with whom the purchase order or contract is placed that the subject matter of the order or contract will be used or sold in accordance with the provisions of this Order. Every person concerned shall be entitled to rely on said Certification, unless he knows or has reason to believe it to be false.

(4) No manufacturer shall use any scarce material described in foregoing paragraph (b) (1), where and to the extent that the use of other material is practicable.

(c) *Applicability of Priorities Regulation No. 1.* This Order and all transactions affected thereby are subject to the provisions of Priorities Regulation No. 1 (Part 944) as amended from time to time, except to the extent that any provision hereof may be inconsistent therewith, in which case the provisions of this Order shall govern.

(d) *Records.* All persons to whom this Order applies shall keep and preserve for not less than two years, accurate and complete records concerning inventories, production and sales, including copies of each purchase order or contract containing the certification hereinabove referred to.

(e) *Audit and Inspection.* All records required to be kept by this Order shall, upon request, be submitted to audit and inspection by duly authorized representatives of the War Production Board.

(f) *Reports.* All persons affected by this Order shall execute and file with the War Production Board such reports and questionnaires as said Board shall from time to time request.

(g) *Violations.* Any person who wilfully violates any provision of this Order, or who, in connection with this Order, wilfully conceals a material fact or furnishes false information to any department or agency of the United States is guilty of a crime, and upon conviction, may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of, or from processing or using, material under priority control and may be deprived of priorities assistance.

(h) *Appeal.* Any person affected by this Order who considers that compliance herewith would work an exceptional and unreasonable hardship upon him, may appeal to the War Production Board setting forth pertinent facts and the reasons such person considers that he is entitled to relief. The Director of Industry Operations may thereupon take such action as he deems appropriate.

(i) *Communications.* All reports required to be filed hereunder, or communications concerning this Order, shall, unless otherwise directed be addressed to:

"War Production Board
Safety and Technical Equipment Branch
Technical and Scientific Equipment Section
Washington, D. C. Ref: L-144"

Issued this 12th day of June, 1942.

J. S. KNOWLSON,
Director of Industry Operations

SPECIAL ARTICLES

EFFECT OF ORCHIDECTOMY ON SKELETAL METASTASES FROM CANCER OF THE MALE BREAST

A SYSTEMATIC study is in progress of the effects of induced hormone imbalance on the course of primary inoperable and metastatic breast cancer in both sexes. Among the procedures employed have been: (1) castration by irradiation of the ovaries; (2) bilateral oophorectomy; (3) the parenteral administration of limited amounts of estradiol monobenzoate; (4) the parenteral administration of testosterone propionate.

The immediate elevation of the serum calcium and subsequent radiographic evidence of extension of the skeletal metastases have been reported[1] in three female patients who received 400 to 500 mgms of testosterone propionate over periods of from 7 to 10 days. A fourth patient (Case I), a male with osseous metastases from a cancer of the breast, received 925 mgms of testosterone proprionate in 17 days. The only subsequent chemical abnormality observed was a slight elevation of the serum calcium level to 11.7 mgms. Measured radiographically, however, the metastatic lesions increased rapidly in number and extent. Pathological fractures of the humeri and vertebrae occurred before death 10 months after treatment.

From the evidence it was concluded that a steroid hormone imbalance due to the administration of testosterone propionate not only failed to inhibit the progress of metastatic mammary cancer but seemed to accelerate the activity of the growth in both sexes.

The effect of surgical castration on the osseous metastases from inoperable mammary cancer has been studied in a male of 72 years (Case II). Bilateral orchidectomy was performed in February, 1942. In the four months since operation evidence which suggests a regression of the growth has come to hand. The ulcerated lesion of the left breast has decreased in diameter from 7 × 4 × 2 cm to 5 × 3 × 1.5 cm. There has been complete relief of bone pain, previously a persistent and troublesome manifestation. Radiographic evidence indicates that the areas of decalcification, representing metastatic deposits of cancer in the ribs, vertebrae and scapula, have shown no increase in extent. Furthermore, in these areas an increased density has appeared, interpreted as a reflection of increased calcification and healing of the lesion. No chemical alteration was noted beyond a recent elevation of the serum alkaline phosphatase (5.9 to 11.1 units).

The rates at which estrogenic substance and 17 ketosteroid were excreted in the urine of these 2 patients were estimated before and after treatment (Case I—testosterone, Case II—orchidectomy). The results are given in Table 1.

TABLE 1

	CASE I	
	Estrogens	Androgens
1/12–15/40	34.0 M.U.	44.5 mgms.
1/15 /40	Daily injections of 50 mgms. testosterone propionate begun	
1/15–18/40	34.0 M.U.	40.9 mgms.
1/18–21/40	22.0 M.U.	41.8 mgms.
1/21–24/40	50.0 M.U.	56.7 mgms.
	CASE II	
	Estrogens	Androgens
2/ 6– 9/42	22.5 M.U.	11.7 mgms.
2/ 9 /42	Bilateral orchidectomy	
2/13–16/42	16.7 M.U.	3.0 mgms.
2/23–26/42	6.6 M.U.	12.0 mgms.
3/ 9–12/42	13.3 M.U.	6.7 mgms.
4/ 1– 4/42	Trace (less) than 4 M.U.	10.2 mgms.

The decrease in estrogen excretion after orchidectomy as well as a stable 17 ketosteroid output are striking features. Control of disease as extensive as that observed in Case II is unusual. It may be unassociated with the operative procedure employed, although this appears improbable.

JOSEPH H. FARROW
FRANK E. ADAIR

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[1] J. H. Farrow and H. Q. Woodard, *Jour. Am. Med. Asn.*, 118: 339–343, January 31, 1942.

FEATHER DEPIGMENTATION AND PANTOTHENIC ACID DEFICIENCY IN CHICKS

Depigmentation of the hair due to deficiency in the filtrate fraction of the vitamin B_2 complex has been demonstrated in rats, dogs and foxes.[1] Similar graying has been reported[2] in rats on a diet low in pantothenic acid. In order to determine whether these deficiencies produce depigmentation in the feathers of birds, fifty-nine Black Minorca chicks, one week of age, were placed on a purified, vitamin-free diet similar to that used by Almquist.[3] In addition, the following crystalline vitamin supplements were given daily by pipette to each chick: 100 micrograms each of riboflavin and thiamin chloride and 50 micrograms each of pyridoxine and nicotinic acid.[4] Vitamins A and D as liver oil were added directly to the diet. Forty-seven chicks received daily in addition to the above supplements 5 micrograms of calcium pantothenate or an amount of yeast extract containing this amount of pantothenic acid as determined by microbiological assay. The yeast extract was made from brewers' yeast extracted with acetone and treated with fuller's earth. Twenty-one chicks as positive controls received 280 micrograms of calcium pantothenate or its equivalent in assayed yeast extract. The average weight of the birds at the beginning of the experimental period was 60 grams. The average weight increase over the 66-day experimental period was 46 grams for the chicks on low pantothenic acid and 151 grams for the birds on high pantothenic acid supplements.

Feather samples taken from the chicks on the low pantothenic acid supplements on the sixteenth day of the experiment showed definite areas of partial depigmentation in both shafts and barbs with some distortion of the shafts and loss of barbules. Such areas were particularly striking in the primary feathers of the wing. Feathers of the group on high pantothenic acid supplements showed little or none of this depigmentation or distortion.

On the thirtieth day, depigmentation was most evident in the newly developed feathers of the ventral and femoral tracts in the low pantothenic acid group. In four of the birds on high pantothenic acid supplements, depigmentation of a lesser degree was noted. The entire group on low pantothenic acid appeared much lighter in color than the positive controls. It was clear that a high level of either calcium pantothenate or yeast extract protected against this distortion and depigmentation of the feathers, whereas the low levels of either, while allowing the birds to grow slightly, did not prevent feather changes.

The depigmentation was manifested microscopically as both a reduction in size of pigment granules and in numbers of these granules. The loss of barbules produced a barring effect particularly evident in the feathers of the femoral tract.

Eight chicks (average weight, 104 gm) receiving the low pantothenic acid supplements and nine (average weight, 212 gm) receiving the high pantothenic acid supplements were killed at the conclusion of the experimental period and tissue samples of liver, kidney, leg muscle and brain were assayed[5] for pantothenic acid by the microbiological method of Pennington, Snell and Williams.[6] The results of this assay are given in Table I.

TABLE 1

	P. A. intake daily	Liver	Kidney	Muscle	Brain
Aver. and range of P. A. content per mg. tissue	Adequate	53.6[51.7–55.7]	34.5[33.3–36.3]	11.6[10.7–13.8]	22.7[19.8–27.9]
	Low	40.9[37.5–44.4]	31.1[23.2–39.1]	3.3[2.7–3.9]	8.9[7.5–10.3]

It is evident that the pantothenic acid content of the kidneys and to a lesser degree the livers of the deficient chicks was only a little less than that of the controls and that the greatest differences were present in the brain and muscle. This is not completely in agreement with Snell, Pennington and Williams,[7] who found that all the tissues of their deficient chicks were considerably lower than those of their positive controls.

The depigmentation phenomenon may be due wholly to pantothenic acid deficiency or some other factor may also be involved. In another experiment on a new group of fourteen chicks, the attempt was made to discover whether the feather depigmentation and distortion were solely a vitamin deficiency effect or resulted partly from inanition. All the chicks in both high and low pantothenic acid-supplemented groups were forced-fed the same amounts of food each day. This was unsuccessful as growth ceased entirely in the chicks on the low pantothenic acid level, and nearly all of them died after two weeks.

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[1] A. F. Morgan, H. G. Davison and B. B. Cook, *Jour. Nutrition*, 15: 27, 1938; A. F. Morgan and H. D. Simms, *Jour. Nutrition*, 19: 133, 1940.

[2] K. Unna, G. V. Richards and W. L. Sampson, *Jour. Nutrition*, 22: 553, 1941.

[3] H. J. Almquist and E. Mecchi, *Proc. Soc. Exper. Biol. and Med.*, 48: 526, 1940.

[4] We are grateful for gifts of crystalline pyridoxine and of calcium pantothenate from Merck and Company, Rahway, New Jersey.

[5] We are indebted to Relda Cailleau for these microbiological assays.

[6] D. Pennington, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 135: 213, 1940.

[7] E. E. Snell, D. Pennington and R. J. Williams, *Jour. Biol. Chem.*, 133: 559, 1940.

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IDENTIFICATION OF SELENIUM INDICATOR SPECIES OF ASTRAGALUS BY GERMINATION TESTS

INDICATOR plants belonging to the genus *Astragalus* are of great aid in locating seleniferous areas that may be capable of producing toxic forage and grain.[1] From chemical analyses of plants collected in the field, 28 species of *Astragalus* are known to be selenium accumulators and indicators, whereas 54 other species of *Astragalus* absorb only small amounts of selenium and are not limited to seleniferous soils.[2] It is important that many of the remaining 218 species in North America and 1,200 species in the rest of the world be examined for their ability to absorb selenium.

The present paper describes a simple test with germinating seedlings that enables one to determine whether or not a given species of *Astragalus* is capable of accumulating selenium. The test is based on an earlier observation that a selenium indicator species tolerates and is even stimulated by a high concentration of sodium selenite, whereas a non-indicator species is severely poisoned by a low concentration of this salt.[3] No other case has been reported in which closely related species differ so markedly in their response to a mineral poison.

It has been found that the addition of 20 parts per million of selenium (as sodium selenite) to the culture solution has no observable effect upon the early seedling growth of an indicator species of *Astragalus*, whereas it completely inhibits root development of a non-indicator species.

The culture technique is an adaptation of a method that has been used for many years.[4] Seeds of most of the species included in these tests were collected during the summer of 1941. To soften their coats, the seeds were treated for from 30 to 60 minutes with concentrated sulphuric acid. They were then soaked in tap water for three hours and subsequently allowed to germinate on wet filter paper in a glass moist chamber. After about 24 hours, when the seedlings were approximately 10 mm in length, they were transferred to culture vessels. A piece of paraffined bobbinet (1/16-inch mesh) was stretched over the top of a 300-cc beaker and fastened by a ligature of paraffined linen thread. This beaker was placed in a 600-cc beaker, and both the inner beaker and the space around it were filled to the level of the netting with culture solution. Twenty-five seedlings were placed upon the netting, with their roots dipping into the solution. Two cultures of each species of *Astragalus* were prepared, one supplied with the usual mineral salts[5] and the other receiving in addition 20 parts per million of selenium (as sodium selenite). The cultures were kept in darkness at 28°–29° C., and a moist chamber was provided for each during the first day by covering the larger beaker with an inverted watch glass. At the end of three days, the seedlings were put in chrom-acetic fixing solution, and the lengths of roots and hypocotyls were later recorded. I am indebted to Dr. Sydney S. Greenfield for assistance in making these tests.

The results are summarized in the following tabulation, in which a *plus* sign signifies a selenium indicator species and a *minus* sign denotes a non-indicator species. The roots of the indicator species made the same amount of growth (25–30 mm) in the absence of selenium and in the presence of 20 parts per million. Root growth of the non-indicator species was completely inhibited in the solution containing 20 parts per million of selenium but amounted to 25–30 mm in the selenium-free solution. The hypocotyls of the non-indicator species in the selenium solution grew only about 5 mm, while those of all the other cultures grew 20–30 mm.

BISULCATI
+ *Astragalus bisulcatus* (Hook.) Gray (Wyoming)
+ *A. haydenianus* Gray (Colorado)
+ *A. oocalycis* Jones (Colorado)
GALEGIFORMES
+ *A. racemosus* Pursh (South Dakota)
– *A. drummondii* Hooker (Wyoming)
LONCHOCARPI
+ *A. osterhoutii* Jones (Colorado)
– *A. lonchocarpus* Torr. (New Mexico)
OCREATI
+ *A. confertiflorus* Gray (Utah)
+ *A. flavus* Nutt. (Wyoming)
PODO-SCLEROCARPI
+ *A. grayi* Parry (Wyoming)
+ *A. pectinatus* Dougl. (Wyoming)
+ *A. rafaelensis* Jones (Utah)
+ *A. toanus* Jones (Nevada)
– *A. canonis* Jones (California)

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[1] For a general review of the selenium problem, see: S. F. Trelease, *The Scientific Monthly*, 54: 12, January, 1942.

[2] O. A. Beath, C. S. Gilbert and H. F. Eppson, *Am. Jour. Bot.*, 28: 887, 1941.

[3] S. F. Trelease and H. M. Trelease, *Am. Jour. Bot.*, 26: 530, 1939.

[4] S. F. Trelease and H. M. Trelease, *Bot. Gaz.*, 80: 74, 1925.

[5] See footnote 3.

− *A. casei* Gray (California)
− *A. pterocarpus* Watson (Nevada)
− *A. sclerocarpus* Gray (Washington)
− *A. tetrapterus* Gray (Nevada)
PREUSSII
+ *A. beathii* Porter (Arizona)
+ *A. pattersonii* Gray (Colorado)
+ *A. praelongus* Sheld. (New Mexico)
+ *A. preussii* Gray (Utah)
INFLATI
− *A. lentiginosus* var. *palans* Jones (Arizona)
SARCOCARPI
− *A. crassicarpus* Nutt. (Wyoming)
ULIGINOSI
− *A. canadensis* var. *carolinianus* (L.) Jones (Wyoming)

The group names in the list are those into which Jones[6] divided the genus on the basis of morphological characters. Using the criterion of physiological differentiation with reference to selenium, it is evident that the groups Galegiformes, Lonchocarpi and Podo-sclerocarpi need taxonomic revision, since each includes both indicator and non-indicator species.

The results of these germination tests are in agreement with those of field observations and growth experiments of longer duration.

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[6] M. E. Jones, "Revision of North American Species of *Astragalus*." 1923.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

REARING GRASSHOPPERS UNDER LABORATORY CONDITIONS[1]

THE rearing of grasshoppers in the laboratory requires considerable care and attention.[2] The food must be grown and supplied daily to the insects, the cages must be cleaned at least once a week, dampness must be avoided, etc.

The present paper describes a simple method for rearing grasshoppers which is being used in the Division of Entomology and Economic Zoology of the University of Minnesota.

Two types of cages are used, a smaller, for the hatching of the eggs and as living quarters for the first instars, and a larger one for growth and reproduction.

Inside dimensions of the smaller cage are 6 × 3½ × 3½ inches. The sides and one of the ends are of wooden boards, the other end is left open for the attachment of a cheesecloth sleeve. The top and the bottom of the cage are made of screen wire cloth, 16 to an inch mesh. The bottom is elevated a quarter of an inch above the surface of the table.

The larger cage is of 12 × 12 × 12 inches inside dimensions. The cage is made of wire cloth 12 to an inch mesh, nailed to the wooden framework. The bottom is elevated a half of an inch above the surface of the table. The lower third of one side is left open for a cheesecloth sleeve as in the smaller cage.

Food consists of a dry mixture of dried brewers' yeast, 1 part; skim milk powder, 2 parts; and dried alfalfa meal, 2 parts by weight. Water is given in shell vials plugged with cotton and laid on the bottom of the cage. Food can be supplied to the newly emerged insects in "Coca Cola" or similar caps from which cork has been removed. It is advisable to put 2 to 3 receptacles with food in the cage as well as 2 or 3 vials of water in order to avoid overcrowding and consequent undernourishment of some insects. One ounce ointment boxes are satisfactory for food containers in the bigger cage.

Grasshoppers are allowed to emerge from the eggs in the small cage. Water and food should already be present before hatching starts. Constant light is provided by bending an ordinary table lamp over the cage—about 3 to 4 inches from the top screen. The insects find the food and water without difficulty. It is important, however, to have the insects reared from eggs in the cage and not to introduce them from the outside after they will already have started feeding on their natural food. After all the insects enter their second instar, they may be transferred to a larger cage, the dimensions of which depend on the number of grasshoppers maintained for use in the laboratory.

The insects do not require any special attention, provided they always have food and water available. Feces which accumulate under the screen bottom may be removed from time to time.

In our experiment, hatching of overwintering eggs of *Melanoplus differentialis* started on May 27 and next molt occurred 5 days later. June 7, when all the grasshoppers had molted, they were transferred to the larger cage. There was no mortality. The time of appearance of the nymphs of the third instar was not noted, but June 9 the nymphs of the fourth instar began to appear, and succeeding molts occurred on June 13 and 20. The first adults appeared on June 24, the total developmental period being 28 days after hatching, during which 6 molts occurred. July 11, the last nymph molted, 31 days after hatching started. The insects were mostly segregated in a circle around the light where the temperature was about 34° C.

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[1] Paper No. 1938, Scientific Journal Series. Minnesota Agricultural Experiment Station, St. Paul, Minn.

[2] E. E. Carothers, "Culture Methods for Grasshoppers. Culture Methods for Invertebrate Animals," pp. 287–291. Comstock Publishing Company, Ithaca, N. Y. 1938.

First death of adults occurred on July 12, 45 days after hatching, and 43 days later half of the adults were dead. The last adult, a male, died on October 26 at the approximate age of 152 days. Until July 31 the insects were kept in a basement laboratory having only artificial light available day and night. On that day the cage was taken to the greenhouse, where it remained till the end of the experiment. The insects behaved normally. They mated and the females oviposited in sod which had been placed on the floor of the cage.

The advantages of this method are obvious. The experimenter needs only to fill the dishes with food when necessary, provide water and occasionally remove the paper with feces from under the cages.

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VITAMIN SYNTHESIS BY A YEAST CONVERTED FROM A HETEROTROPHIC TO AN AUTOTROPHIC HABIT[1]

Saccharomyces cerevisiae is generally accepted to be heterotrophic with regard to a number of vitamins. However, the writers have succeeded in inducing ten strains of this yeast to grow without an exogenous supply of thiamin, pyridoxin, inositol and pantothenic acid; in addition, a rich growth without even biotin has been induced in the case of at least one strain. Thus has evolved a yeast that will readily grow in a synthetic medium containing no vitamins. This building-up process of autotrophic habit was accomplished by means of prolonged incubation, by the use of a large quantity of inoculum during the initial stages and by successive transfers to solutions from which one of the essential vitamins was omitted. Ordinarily from four to seven passages sufficed to induce the yeast to grow as well in the absence of a given vitamin as it did in its presence. Then a second vitamin was omitted from the medium, and the process was repeated until a complete, or nearly complete, autotrophic habit was established.

Yeast is a good source of vitamins, but since in its turn it is dependent upon an exogenous supply of growth factors, the question arises whether or not a conversion from heterotrophic to autotrophic habit might not affect vitamin synthesis and storage and thus leave the cell devoid of vitamins. In order to answer this, the writers grew their completely autotrophic strain of yeast in a synthetic medium prepared from vitamin-free chemicals. The cultures were incubated at 25° C for four days; the ensuing crop of cells was then harvested, washed, dried and tested for the various vitamins. This was done by weighing 0.2 gram of the cells for each 100 ml of the nutrient solution, boiling for 5 minutes to extract the soluble parts, filtering, sterilizing and inoculating with the test organisms.

The following organisms were used to detect the different vitamins: *Pythium ascophallon* for thiamin; *Ceratostomella ulmi* for pyridoxin; *Lactobacillus casei* for riboflavin; *Brucella suis* for nicotinamide; *Clostridium acetobutylicum* for para-aminobenzoic acid and strains of *Saccharomyces cerevisiae* for inositol, pantothenic acid and biotin.

Two lots of nutrient solution were prepared. The first lot, containing no vitamins, was divided into two portions; the first portion was used as the control, while the other contained, in addition, the water-soluble parts of the yeast. The second lot of the nutrient medium was divided into eight portions; each portion received all the vitamins mentioned in this paper except one. For instance, the first received all the vitamins except thiamin; the second received all except pyridoxin, and so on down the list. Then each one of the eight portions was divided into halves; the first was used as the control, while the water-soluble parts of the yeast were added to the second half to furnish the missing vitamin.

The bacterial cultures were incubated at 30° C, the yeasts and fungi at 25° C. Very slight or no growth was observed in all the controls, while a rich growth was made in all solutions containing the substances extracted from the yeast cells. This indicates that our strain of autotrophic yeast is capable of synthesizing in appreciable quantities all the vitamins mentioned in this paper.

In the building-up process of vitamin synthesis, the writers have developed many strains of yeasts from a single one. Some of these synthesize and store considerable quantities of vitamins; others produce smaller amounts, or almost none. This work will appear later.

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BOOKS RECEIVED

American Standard Definitions of Electrical Terms. Pp. 311. American Institute of Electrical Engineers, New York. $1.00.

BROWN, F. E. *A Short Course in Qualitative Analysis.* Revised edition. Pp. vii + 367. D. Appleton-Century Company, Inc. $2.60.

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Collateral Readings in Inorganic Chemistry. Second Series. Edited by L. A. GOLDBLATT. Illustrated. Pp. viii + 198. D. Appleton-Century Company, Inc. $1.40.

SMART, W. M. *Foundations of Astronomy.* Pp. vi + 268. Longmans, Green and Co. $4.20.

WATSON, H. B. *Modern Theories of Organic Chemistry.* Second edition. Pp. vii + 267. Oxford. $5.00.

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